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CONTENTS.

	PAGE
Educational Reform	851
Madras Fisheries Department	854
Dependence of the "Visibility" of an Object on its Apparent Size. By C. S. Karve, B.Sc.	855
Occurrence of *Derris elliptica* in India. By S. Krishna and T. P. Ghose	857
On the Shape of the Golgi Bodies in Invertebrate Eggs. By M. K. Subramaniam, M.A., D.Sc.	859
Obituary—Dr. N. A. F. Moos, D.Sc., L.C.E., F.R.S.E. By Rao Saheb M. V. Unakar.	862
Centenaries in June 1936	864
Award for Scientific Manuscript	866
Letters to the Editor.	867
Research Notes	878
Supplement to "*Current Science*"—The Mechanism of Enzyme Action. By Prof. A. Fodor	879
Recent Investigations into the Principles of Irrigation and Cultivation of Orchards. By Sohrab R. Gandhi, M.Ag.	892
Sugar Industry of India (1934-35)	897
Lady Tata Memorial Trust	897
Science Notes	898
Everest Expedition	903
Academies and Societies	904
University and Educational Intelligence	905
Reviews	906
Forthcoming Events	914

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Educational Reform.

ACCORDING to the Press report published recently the Government of India is contemplating the appointment of a special committee to suggest reforms in the present educational syllabuses and methods, as a sequel to the report of the Sapru Unemployment Committee. The special committee is proposed to be assisted in its deliberations by two or more British experts on technological education. In the meantime the Central Government is considering the report of the Sapru Committee with a view to discover the extent and direction of the application of its proposals for relieving unemployment, in the light of the opinions received from the provinces. The main conclusion of the Sapru Committee is that the problem of unemployment will ultimately be solved by the institution of more technical schools, and by the improvement and adaptation of the existing system of education to the needs of a growing community. The Committee has also suggested measures of reform in the conditions of service with reference to wastage and recruitment. The general aspects of unemployment have been discussed by a number of special committees, the legislative bodies and the leaders of public opinion, who have expounded the causes and remedies of such unemployment. The announcement in the Press that a new committee is speedily to be appointed might lead to the impression that Government is not already surfeited with documents, and it is almost certain that this new committee, however much it may be strengthened by the British experts, is not going to be the last. The problem of unemployment is far too complicated in India to invoke the aid of educational reform alone to provide remedies.

Every school girl knows that unemployment results where the output of trained men and women exceeds the power of their absorption in occupations for which they are fitted. The institution of technical schools and colleges is not a remedy, for they are bound to become crowded by young men and women who, irrespective of their tastes and aptitudes, must necessarily flock to them in the hope of finding suitable employment at the end of their training, and unless commerce and industries keep pace with the annual output of a large number of technical graduates and certificate holders, there is bound to be unemployment among

them, unless they have sufficient capital to launch upon independent commercial or industrial enterprises. The prosperity of these private industries, however, depends upon favourable markets for their products, and also upon their survival value in their competition with the large financial syndicates. We fully sympathise with the desire to encourage technical training, though we feel bound to emphasise the possibility that such training of experts is bound to produce unemployment among them far more speedily perhaps than general education has done among the purely academic graduates. The advocacy for the extension of technical schools might temporarily relieve congestion in the universities, provided careers are offered to all who benefit from training in such institutions, and provided also that Government and other employing agents abandon their insistence on the university degree as a passport to service. The growth and popularity of the technical institutions are generally governed by the rapid expansion and development of commerce and industries in the country, which must demand in an increasing measure the services of a large number of highly trained men. They are the necessary ingredients in the normal evolution of the economic life of the country and their significance and value to its prosperity are practically lost when treated as emergency measures. The causes which have led to unemployment in other countries are not the same as in India; in the former, machinery and women have gradually ousted men, and in the latter, an eager contest for Government posts, a scramble for prizes in all the learned professions which only the specially gifted persons can win and finally the great concentration of the rural population in towns must account for the economic disturbance. This unsatisfactory state of affairs is to be accounted for by the fact that the education imparted to young men and women has generally produced a profound aversion for the profession of their fathers and a fatal madness for positions of power and patronage in the Government service. The attraction, therefore, of the universities and colleges to men who may or may not possess the power to profit by their discipline is frequently alleged as the cause of unemployment in India and naturally the remedy is proposed to be sought by introducing reforms in education. But it must be remembered that so long as the employer requires qualification in either reformed or unreformed education such as colleges and schools can impart, for employment, we need entertain no hope of betterment. It seems to us that the cure for unemployment lies neither in the reforms of education, nor in the establishment of technical institutions, but in the replacement of the university degree by Government examinations so designed as to suit the requirements of the different branches of service, the redistribution of population so that the sparsely populated and unexploited areas in India are developed, the encouragement of emigration within the Commonwealth to enterprising Indians by offering them facilities for settling and acquiring property, and Indianisation of all the branches of service including the Railways.

Although the problem of unemployment is not directly connected with the existing system of education, yet it has not kept pace with the spirit of the modern tendencies in public life. The conception of a New World which the Constitutional Reforms will shortly introduce, is stored, with riches waiting for the Minister of Education to be explored, assimilated and turned to national account. Before him lie the greatest possibilities of the future, perhaps the most fascinating prospect of a great creative effort and an endless field of achievement. Education, interpreted in a broader sense than any acknowledged by its professors, is not at present the dominant concern of the State. The dominant interests of the public are the economic and the political, and education revolves as a dark subsidiary planet in a distant orbit round these self-important bodies. But real and important as they are, they have very little claim to dominate the life of the community for ever. It is this subordinate position into which education has been forced, which must account for the retardation of progress in the country. In the coming order of social and political system for whose appearance the new Reforms have raised hopes, education should be an equal partner in a community of interests. As long as education is made to give way to the demands of politics and economics, which we may arrange into the League of Nations, individualism or socialism, so long we shall make no headway, but rather reinstate on another level the social evils we are trying to cure on this. The fortunes of the

community do not depend on the rearrangement of the political and economic puzzle. They lie in another region, the minds and characters of the citizens which are the fundamental assets of the State. The educational reform to which we look forward is the creation for education a position where, though it may not claim to dominate politics and economics, it shall not permit itself to be dominated by them. It should have the rights and privileges of Dominion Status in the Commonwealth of State interests, in order that its genius might develop on its own lines, freed from the tangle of other departments and the electioneering vicissitudes of party politics.

But as things now are, the control of education is tied up to the wheels of the political chariot, and whatever disasters overtake this chariot, they are immediately reflected in a corresponding injury to the interests of education. The more intelligent section of the public has not visualised the anomaly of a Minister of Education, who has set on foot what is practically a life's work, being thrown out of office, because the party to which he belongs has come to grief in the elections on totally different ground, and his successor, not being interested in his ideas, pulling to pieces the far-reaching plans laid by the defunct member. It is this egregiously vicious system of collective responsibility of the cabinet, which has arrested the development of education, by being associated with interests of a lower level of value. Political vicissitudes break its continuities and discredit its significance. The first step in the educational reform, as we conceive it, is to free the management of its affairs from the baleful political exigencies, and education must cease to be a party product.

The second stage in the process of reform is to abolish from the theory and practice of education the pernicious idea that it has a tripartite division, elementary, secondary and higher, arranged in order of importance, and designed for the different classes of people. The growth of the human mind is continuous and, whatever agency is employed to promote its development, it must be a unitary whole. A great deal of intellectual snobbishness has arisen by treating education as distinct compartments, which, on the other hand, must be conceived as the bond of union which embraces the mind in its entirety. The human mind is not conscious of its own divisions corresponding to the three grades, which, however necessary for administrative purposes, represent only a common enterprise. The conception of education as a unitary process of civilising the human mind amounts practically to the elimination of the examination system. We have assigned to examination a value far greater and more important than really belongs to its function and purpose. This hand maiden now dominates and overshadows the entire household of education, which has quietly receded into the background and its restoration to its proper position of the legitimate mistress is a measure of reform which must necessarily follow the change of our conception of its ideals and functions, as the greatest reconciling element in social life. In the mansion of education, there is a single story, which may be many-sided but still single.

The present system of education is not, as is commonly and frequently criticised, rooted in the life of the people. Its purpose is not relevant to their needs. It is the creation of Government to suit the special needs of administration. It supports their interests and embodies their prejudices. It brings a foreign culture imposed upon the genius of the people from above by the ruling people who think that they know what is good for the country. The country suspects the motive behind it all. These criticisms are as familiar to us as the things by which we are surrounded from childhood. The people are undoubtedly keen for education, if it is good for something, but they are naturally indifferent to what if offered to them in the name of education leading their children nowhere. Education is mixed up with a multitude of other extraneous things, which have nothing to do with it, and of which people do not approve,—institutions and interests which in a very subtle but powerful way it bolsters up and perpetuates. They agree with everything we might tell them about the need and urgency of education, but the actual system and the purpose of education now in practice they distrust. This feeling which is undoubtedly widespread explains the prevailing indifference of the working classes to education. The reform of education must attack this indifference; it can do so only by making the schools so efficient and popular that children will cheerfully and of their own accord come to them, and will not willingly leave them. It is through

children that education hopes to reach the parents and society, and it must be remembered that every child who leaves the school unwillingly is a missionary for education, and everyone who leaves it in a contrary frame of mind is a dangerous force on the other side.

We cannot enter here into all the general and special aspects of educational reform, but can only indicate its general principles and the future policy of its control and management. If we think of education in all its bearings and its nature, as lifelong, as interpenetrating all occupations, as teaching every man and woman of doing their work in a better and more intelligent way, as co-extensive with the entire field of social activities, then education should be autonomous in its own territory. This reform being effected, all else will follow.

Madras Fisheries Department.

AS in the previous years, the Administration Report of the Madras Fisheries Department for the year 1934–35 marks another year of continued progress in the working of the Department under the able and enlightened guidance of its Director, Dr. B. Sundara Raj. The year was one of prosperity to the fishing industry on both the West and the East Coasts in spite of the fact that sardine, the most important shoaling fish of the Presidency, was absent during the year and the mackerel was only moderately abundant.

For the students of Indian ichthyology, both pure and applied, the Report is a regular mine of information regarding the progress in our knowledge of the bionomics of some of the principal food fishes of India. During the year under report the discovery of the breeding grounds of the oil-sardine (*Sardinella longiceps*) and the direct proof of the establishment of Catla (*Catla catla*) in the Cauvery river are announced, and it is a pleasure to note that the persistent efforts and the continued application on the part of departmental officials have been crowned with success. One can now confidently hope that the utilisation of the knowledge thus gained will lead to a much greater prosperity to the fishing industry of the Province.

It is also a matter for gratification that the spawning season, eggs and early stages of the half-beak (*Hemirhamphus georgii*) have been worked out and it should now be possible to deal more adequately with the important seasonal fishery of this species in the Palk Bay. A great advance has been made in the breeding of *Etroplus* and it has been proved that it can thrive in ponds where the elimination of natural enemies, such as murrel, snakes and frogs, is not practicable. This fact renders the fish very suitable for stocking ponds, etc.

As was to be expected, the adverse effects of the construction of the Mettur Dam are now being gradually felt in the decrease of the fisheries of the Cauvery below the dam. Unfortunately throughout India no attempt is made to reconcile the needs of the fisheries and of the irrigation projects; the latter invariably lead to the deterioration of the former, resulting in the undermining of a valuable source of food supply.

According to the Director, "The most noteworthy result of technological research is the production for the first time of sardine oil with a vitamin A potency equal to one-fourth that of cod liver oil and the discovery of four other Indian sea fish which yield oils with a high vitamin A content. The remarkable fact has also been ascertained that South Indian shark liver oil is more than 4·2 times as potent in vitamin A as cod liver oil." These researches indicate that a very valuable source of vitamin A will soon be brought within the reach of the poor people leading ultimately to a great improvement in their health.

Besides the fisheries (*sensu stricto*), the Department achieved considerable success in the rearing of Pearl oysters and the possibilities of the production of culture pearls in India on a commercial scale can now be visualised. It is, however, regretted that two and a half years of cultural experiments in the Pulicat edible oyster beds had to be terminated abruptly owing to a disastrous drought during the year under report. All the same, these experiments have furnished precise data concerning the zone at which maximum spatfall occurs and the reason for such occurrence. The Chank market showed a glut and very little business was done, but in spite of the fall of revenue from this fishery, research on Chank Fisheries was continued with considerable success.

The activities of the Department comprise, besides administration and scientific research, supply of biological specimens to universities and educational institutions in India, anti-malaria work by the introduction of larvicidal fishes, socio-economic work such as education of fishing people, establishment of co-operative societies for their benefit, etc., propaganda in the form of rural pisciculture, exhibitions, etc., and fishery legislation. Under the heading of "Publications" attention may be directed to *Bulletin on Marketable Fishes* and *A Popular Account of Fishery Activities* which, when published, will greatly enhance the prestige of the Department and will enable the lay public to evaluate for itself the advantages it can receive from the proper working of a scientific fisheries department.

The Expenditure and Revenue of the Department shows an adverse balance of Rs. 1,27,086–4–1, but when the vast advantages the Department confers on the fishing people and the production of a healthy, nutritious diet for the general public are taken into consideration, the subsidy of a lakh and a quarter of rupees from the Provincial revenues seems insignificant. But it seems that in spite of considerable efforts on the part of the Department the real significance of the fisheries is still not fully realised. In the opening paragraph of the introduction the Director says that "indications are not wanting that Fisheries as a latent source of food and wealth has not so far received adequate recognition. Within the last fifteen years the question of the continuance of the Department as a national service has been pressed on Government's attention on no fewer than six occasions. The findings of the census of 1931 that agriculture has reached its maximum production under present conditions and the Presidency can no longer feed itself, is a serious warning to the country that attention should now at least be directed to fisheries as the only other prime source of food-supply, and as a valuable addition to the country's wealth." It may here be recalled what Surgeon-Major Francis Day observed in his *Report on the Fresh Water Fish and Fisheries of India and Burma* (p. ccxxxvii). He stated "how great must be the moral responsibility of legislators, who, living amongst a population such as exists throughout India, more than half of whom would consume fish could they procure it, have permitted the depopulation of the fresh-water fisheries, and allowed the destruction of so great a source for the supply of animal food. Now that it clearly appears millions would eat fish could they obtain it, surely the re-population and future protection of these fisheries will be considered an important subject for consideration as a means of supplying loss of physical powers and nervous energy." The value of this unlimited food-supply of high quality becomes inestimable during famines when crops fail owing to floods or drought. Attention may here be directed to the fact that the Royal Commission on Agriculture made strong recommendations for the economic exploitation of the fisheries in India principally with the idea of improving the physique of the agriculturists whose ill-balanced diet received the attention of the Commission.

Dependence of the "Visibility" of an Object on its Apparent Size.

By C. S. Karve, B.Sc.,
Fergusson College, Poona.

IN choosing suitable objects at different distances as landmarks for making observations on "visibility" in meteorological practice, one of the conditions that is considered desirable is that the objects should subtend at the eye of the observer about the same angle. It is also generally known that other conditions remaining the same, an object of smaller angular size ceases to be visible at a shorter distance. In order to obtain some definite information regarding the manner in which our estimate of visibility would be affected if the size of the object is allowed to vary, some experiments were carried out during the last few months in the grounds of the Fergusson College, Poona. The objects under observation were square sheets of white paper pasted on a large blackboard. This ensured uniformity of background and similarity of illumination. The size of the board was about $5' \times 4'$. Five different sizes of paper were used, the sides of the squares being 2·75 cm., 5·5 cm., 11 cm.,

22 cm. and 33 cm. Observations were made at different distances from the board nearly normally with the help of a Wigand Step-Visibility-Meter (' Stufen-sicht-messer '). The

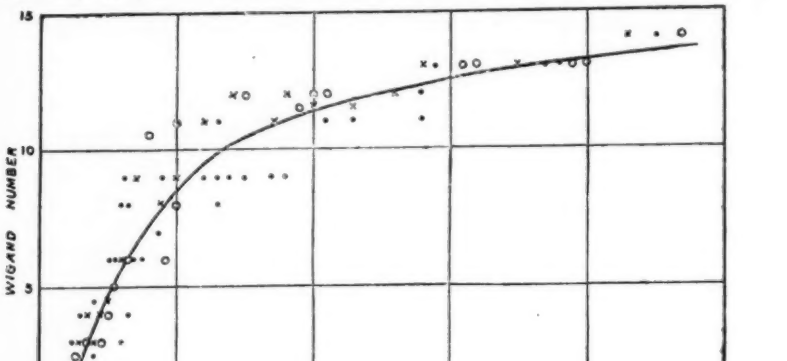

Fig. 1.

White object against black background. Illuminated by sky-light.

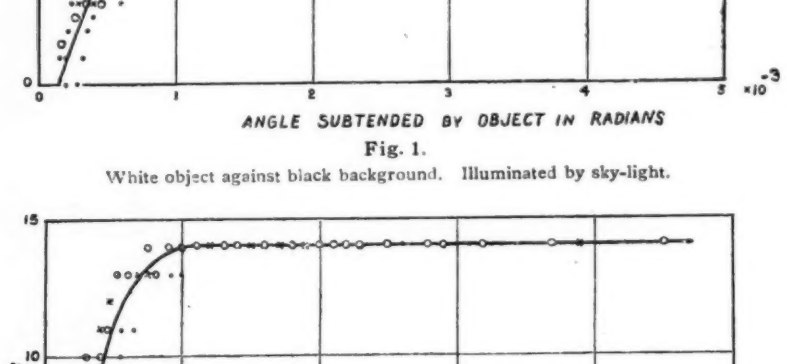

Fig. 2.

White object against black background. Illuminated by sunlight.

distance of the place of observation from the object varied from 50 metres to 180 metres.

The visibility meter consists of a series of 14 ground-glass discs of graded degrees of mattness, any one of which can be placed in front of the observer's eye. A measure of the distinctness with which an object is seen is given by the number of the disc through which, when the object is viewed, it becomes just unrecognisable from the surroundings. Wigand fixed the scale of the instrument in such a way that when an object, having very good contrast from the surroundings is viewed in perfectly clear weather through disc No. 14·3, the object would become just invisible. The grading of the discs is such that two discs with numbers m and n when superposed produce the same effect as a single disc of number $m + n$.

The observations taken on a number of *very clear* mornings with different sizes of objects and different distances of observation are plotted in Fig. 1. Separate signs are used to indicate observations taken on different days. The continuous line is the mean curve drawn through the plotted points. In order to bring together all observations to the same scale, the angular size of the object at the observer's eye is plotted against the distinctness with which the object was seen (as measured by the disc-number of Wigand Visibility-Meter at the threshold of recognition). It will be seen that as the object increases in size from a very small value, the distinctness increases rapidly up to an angular size of about $1{\cdot}5 \times 10^{-3}$ radians or (5′ of arc) and thereafter the increase is much less rapid. The Wigand number practically approaches the value 14 when the angle is 5×10^{-3} radian or 17′ of arc. 0·5° seems to be a safe lower limit of size for visibility landmarks.

As one may expect, there is a dependence of visibility on the lighting of the object. Another series of observations taken in the evening, also in very clear weather but with sunshine falling on the board, are plotted in Fig. 2. In this case, as the apparent size of the object decreases, the distinctness is little affected until a size of about 3′ is reached after which it diminishes very rapidly. The difference between the curves when the illumination on the object is altered shows that if a distant tower or pillar is chosen as a visibility landmark, the estimated visibility will, other conditions remaining the same, depend also on the relative position of the sun, observer and object.

The bearing of these results on the problem of determining vertical visibility in the atmosphere by observations of pilot balloons is obvious but this question is complicated by a number of other factors, such as the size and colour of the balloon, the colour and brightness of the sky, the altitude of the balloon at which observations are taken, the manner in which the transparency of the atmosphere varies in the vertical, etc.

The Wigand Visibility-Meter used for the above observations was kindly loaned by the India Meteorological Department. The observations were taken at the suggestion of Dr. K. R. Ramanathan, Meteorologist.

Occurrence of *Derris elliptica* in India.

By S. Krishna and T. P. Ghose,
Chemical Branch, Forest Research Institute, Dehra Dun.

DERRIS root is at present an important article of trade since it is a potent insecticide, acting both as a contact and stomach poison to aphids and caterpillers infesting vegetables and fruits. Moreover, being non-poisonous to man and animals, it is preferred to arsenical and other poisonous insecticides used as spray or dust on vegetable food products. In animal husbandry it has proved very effective against "Warble Fly", poultry pests such as "Red Poultry Mite" and it forms the basis of some proprietory sheep dips. In view of these uses there is a growing demand for Derris and the supply of good quality Derris root does not appear to be in excess of the demand at the present moment.

Derris is a general name applied to several species of Derris, native, throughout the Tropics. But *Derris elliptica* and *Derris malaccensis* are at present the chief source of Derris of commerce and they come mostly from Malaya, Sarawak, British North Borneo and the Dutch East Indies where the cultivation of these species has greatly been increased—within recent years. In Philippines,[1] Belgian Congo,[2] New Guinea[3] and other places where *Derris* species are indigenous, attempts are being made to increase the production by cultivation of suitable strains.

Several species of Derris are known to occur in India; of these *Derris robusta* and *Derris scandens* were examined by McIndoo, Sievers and Abbott[4] in 1919 and both were found to be avoid of insecticidal properties. *Derris uliginosa*, which occurs in fair abundance in certain parts of Bengal and Assam, was examined by Tattersfield in 1926–27 and was found to possess very little insecticidal properties. *Derris elliptica*, which is known

[1] *University of the Philippines Natural and Applied Science Bull.*, Oct. 1933, **3**, No. 2.
[2] *Bull. Agricole du Congo Belge*, 1934, **25**, No. 3.
[3] *The New Guinea Agri. Gazette*, 1935, **1**, 38.
[4] *Jour. Agr. Research*, 1919, **17**, 177-200.

to have insecticidal properties, was, however, not generally known to occur in India. Thus there appeared very little possibility for supply of Derris root possessing insecticidal properties from India. In 1932 the Agricultural Expert to the Council of Agricultural Research in India once again raised the question of making a thorough investigation into the insecticidal properties of *Derris uliginosa*, so that, if it was found to contain constituents having insecticidal properties, it would open an outlet in trade for this indigenous product and would provide the country with a cheap insecticide. Mr. H. S. Mullick, Deputy Trade Commissioner, London, in a note to the Indian *Trade Journal* (March 31, 1932), made similar suggestions and remarked that if *Derris elliptica* and *Derris malaccensis*, which did not occur in India, could be cultivated in this country, it would find a ready market in the United Kingdom. Accordingly, at the instance of the Inspector-General of Forests, chemical examination of different species of Indian Derris, particularly *Derris uliginosa*, was taken up with a view to determine their rotenone and allied insecticidal principle contents. Samples of *Derris uliginosa* roots from plants of different age, collected during different seasons of the year, were received from the Sundarbans and Chittagong in Bengal. The total ether extract of these roots, which is supposed to extract most of the insecticidal principles, was found to vary from 1·2 to 1·9 per cent. and although the ether solubles gave distinct colour test for rotenone and allied bodies, no rotenone could be isolated. In view of the very low ether solubles content and non-presence of rotenone in weighable quantities, this species of Derris may be regarded as having no commercial possibility.

While the above investigation was in progress, the Conservator of Forests, Assam, reported the occurrence of *Derris elliptica* in that province and a sample of root, collected from Dibrugarh in Lakhimpur Forest Division, when analysed, was found to give 2·5 per cent. of ether extract and 0·74 per cent. of rotenone. This was encouraging because this was the first sample of *Derris elliptica*, of purely Indian origin, which contained rotenone. *Derris elliptica* has now been found to occur in several parts of the plains of Assam and samples of roots from plants of different ages were obtained from these localities. The results of analysis of these samples are given in the following table:—

Analysis of Derris elliptica *from Assam.*

Species	Locality	Description	Age of plant	Moisture per cent.	Total ether extract per cent.	Rotenone per cent.	Remarks
D. elliptica ..	Dibrugarh, Lakhimpur Division	..	..	8·7	2·54	0·74	
		(i) Thin roots diam. 1/8″—1/2″	..	2·7	1·70	0·20	
		(ii) Thick roots „ 1/2″—1 3/4″	..	5·3	1·0	..	Rotenone not weighable.
		(i) Thin roots „ 3/8″—1/2″	..	4·3	3·03	1·08	
		(ii) Thick roots 1/2″—1 1/4″	..	5·7	1·60	0·14	
Do. ..	Dobaka Reserve, Nowgong Division	(i) Thin roots „ 1/8″—3/8″	18—24 months	3·5	4·5	2·4	
		(ii) Thick roots „ 3/8″—1″		3·8	2·7	1·0	
Do. ..	do.	(i) Thin roots „ 1/8″—1/4″	12—18 months	1·7	4·53	2·41	
		(ii) Thin roots „ 1/4″—3/8″	18—24 months	3·9	4·14	2·26	
		(iii) Thick roots „ 3/8″—1/4″	3 years and above	5·9	2·66	1·01	
Do ..	Kalichara, Kachar Division	(i) Thin roots „ 1/8″—3/8″	..	4·9	4·04	2·34	
		(ii) Thick roots „ 3/8″—1″	..	1·3	3·77	1·92	
Do. ..	Guma Range Goalpara Division	(i) Thin roots „ upto 1/2″	..	2·6	2·49	1·45	
		(ii) Thick roots „ 1/2″—1″	..	4·49	1·18	0·94	

From the above table, it is apparent that Indian Derris root, even when containing a fair amount of rotenone(2·5 per cent.), cannot be regarded as of good quality, specially as its total ether solubles are low. Nevertheless, the present results show that *Derris elliptica* of average rotenone content is available in India and if care is taken to augment the supply by cultivation of proper strain in suitable localities, a valuable trade in Derris can be developed.

On the Shape of the Golgi Bodies in Invertebrate Eggs.

By M. K. Subramaniam, M.A., D.Sc.,
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IN a recent paper[1] Professor Gatenby mentions that at the Second International Cytological Congress held at Cambridge several scientists expressed grave doubts about the existence of the Golgi apparatus as a permanent cell component. Though I have not come across any recent paper expressing such doubts, the attempt of Dr. Gatenby in trying to establish the presence of the Golgi apparatus once again in his paper reflects that even after 38 years after its discovery there exists a body of scientists which does not believe in its existence. After a perusal of the papers of Strangeways and Canti,[2] Walker and Allen,[3] Tennent, Gardiner and Smith[4], I have been attempting to analyse the probable reasons for this disbelief. Ever since the discovery of the apparatus there has been a lack of unanimity of opinion even on major questions. The points in dispute have varied from time to time. Golgi and his pupils believed that the apparatus should necessarily have a reticular structure. This was shown to be an error by Weigl who with his co-workers demonstrated that in invertebrates the apparatus has the form of discrete bodies. Gatenby and Bowen demonstrated the duplex structure in invertebrates and Bowen after a wide search came to the conclusion that there is no representative of the idiosome of the discrete bodies in relation with the network. Parat and his collaborators from vital staining experiments came to the conclusion that the Golgi apparatus as seen after silver and osmic technique was an artifact and that the real Golgi apparatus was the neutral red staining vesicles or bodies to which the name 'Vacuome' was applied. Thus so many unsolved problems have arisen that grave doubts have been engendered in the minds of some scientists. The best course to adopt in the circumstances is to attempt to fill up the gaps in the existing knowledge regarding the apparatus. I believe that uncertainty about the following points has been responsible for the scepticism expressed. (1) Is there any relation between the various shapes of the apparatus found in invertebrates and is there any possibility of deriving one from the other? (2) Is the network found in vertebrate somatic cells derived from the discrete bodies of invertebrates and, if so, what is the fate of the chromophobic or idiosomic region? (3) What is the function of the Golgi apparatus in all types of cells? (4) Is there any relation between the Golgi apparatus and the Vacuome? Unless these problems are solved there will exist cause for scepticism.

In this communication I shall try to deal with one of the questions raised and analyse the various shapes of the Golgi apparatus described in the eggs of various invertebrate animals and attempt to interpret these shapes in the light of a common basic procedure. Cytologists working on the phenomena of oogenesis have ignored many of the suggestions of the students in other branches of the study, especially that of Bowen.[5] This lack of a clearer understanding of the shape of the Golgi apparatus in oogenesis is reflected even in reviews on the subject. Hence, I shall attempt to put all the available facts into a connected whole taking into consideration the already

[1] Gatenby, J. B., *Quart. Journ. Micr. Sci.*, **1936**, **78**, 387-397.

[2] Strangeways, T. S. P., and Canti, R. G., *Quart. Journ. Micr. Sci.*, **1927**, **71**, 1-14.

[3] Walker, C. E., and Allen, M., *Proc. Roy. Soc. London*, (B), **1927**, **101**, 468-483.

[4] Tennent, D. H., Gardiner, M. S., and Smith, D. E., *Carnegie Instn. Wash. Publn.*, **1931**, **27**, No. 413.

[5] Bowen, R. H., *Quart. Journ. Micr. Sci.*, **1926**, **70**, 75-113, 193-217, 395-451.

established knowledge in spermatogenesis and secretory phenomena.

In the earliest oocytes of some animals the Golgi apparatus is said to occur as a mass without any differentiation into an osmiophilic region and an idiosome. In some other early oocytes as well as in growing ones the apparatus has been described in a variety of ways. Granular, vesicular and batonette shapes are commonly referred to. In the ring and batonette shapes differentiation into chromophilic and chromophobic regions have been observed. The question arises whether all these could be derived from the Golgi mass without any differentiation into osmiophilic and osmiophobic regions or whether the shape is fixed. Curiously enough Nath[6] and Harvey[7] seem to consider that the shape is fixed. Nath in the earliest oocytes of scorpions[8] described "a few clearly-defined curved rods lying on one side of the nucleus". But in *Culex*,[9] *Dysdercus*,[10] *Periplaneta*[11] and *Pheretima* he describes vesicles and especially in *Pheretima* he attempts to interpret the various other shapes that he observed as caused by improper fixations and optical sections. In a recent paper[12] he mentions that the Golgi apparatus is polymorphic, but I have not been able to make out whether that applies to oogenesis also.

Harvey, on the other hand, considers that there can only be one form of Golgi apparatus in invertebrates and that resembling the dictyosomes. He had previously described in the oogenesis of *Ciona intestinalis*[13] the Golgi apparatus occurring as "argentophil vesicles and irregular masses" but in a recent paper he has ignored his previous results. The reason for such a procedure becomes apparent when he remarks, while criticising Nath's work, that "there can be no connecting link between these vesicles and the net-like Golgi apparatus characteristic of vertebrate cells which is the fundamental absolute to which all questions of the form of Golgi apparatus must ultimately be referred". Thus the very existence of the other shapes recorded are questioned. In this he does not attempt to interpret or refer to similar shapes observed by other workers in spermatogenesis and secretory cells of both vertebrates and invertebrates.

That hollow spheres have an existence could be made out from the fact that the main reason of Hirschler[14] for postulating an "apparatinhalt" was that in the case of hollow Golgi spheres the central contents could not possibly be the same as the external cytoplasm. Hirschler had described the Golgi apparatus in the eggs of *Ciona intestinalis* as having ring and half-ring shapes. Gatenby[15] records in some Lepidoptera batonettes becoming converted into rings. Beams and Goldsmith[16] in the salivary gland cells of *Chironomous* present photomicrographic evidence of ring and half-ring shapes occurring side by side. Finally, Bowen's[17] figures of the acroblast and the Golgi remnant in *Euschistus euschistoides* show that in the case of the dictyosome shaped like a U, sections in some particular planes produce rings as the Golgi body necessarily has three dimensions.

It is quite possible as my experience has shown,[18,19] that in some eggs the shape is fixed throughout oogenesis. But that fact alone does not entitle one to define the shape of the Golgi bodies as fixed in all types of eggs. Variations in the shapes of the network—like Golgi apparatus of vertebrate somatic cells led Bowen[20] to conclude that the Golgi apparatus may assume any shape, the reticulum or network being only one expression of its protean appearance. How different is this conception from that of Nath and Harvey!

The Golgi apparatus of secretory cells and spermatocytes is in no way different from

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[6] Nath, V., *Quart. Journ. Micr. Sci.*, 1930, **73**, 477–507.

[7] Harvey, L. A., *Proc. Roy. Soc. London*, (B), 1931, **107**, 414–441–455.

[8] Nath, V., *Proc. Roy. Soc. London*, (B), 1925, **98**, 44–58.

[9] Nath, V., *Zeit. zellf. mikr. Anat.*, 1929, **8**, 655–690.

[10] Bhandari, K. G., and Nath, V., *Zeit. zellf. mikr. Anat.*, 1930, **10**, 604–624.

[11] Nath, V., and Mohan, P., *J. Morph.*, 1929, **48**, 253–279.

[12] Nath, V., *Quart. Journ. Micr. Sci.*, 1933, **76**, 129–143.

[13] Harvey, L. A., *Proc. Roy. Soc. London*, (B), 1927, **101**, 136–162.

[14] Hirschler, J., *Arch. mikr. Anat.*, 1918, **91**, 140–182.

[15] Gatenby, J. B., *Quart. Journ. Micr. Sci.*, 1917, **62**, 407–465.

[16] Beams, H. W., and Goldsmith, J. B., *J. Morph.*, 1930, **50**, 497–517.

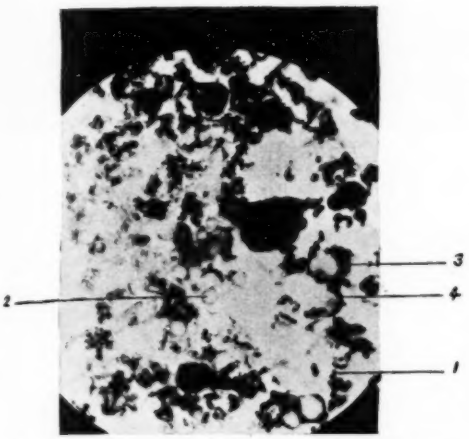
[17] Bowen, R. H., *Biol. Bull.*, 1920, **39**, 316–359.

[18] Subramaniam, M. K., *Proc. Ind. Acad. Sci.*, 1934, **1**, 6, 291–316.

[19] Subramaniam, M. K., and Gopala Aiyar, R., *Proc. Ind. Acad. Sci.*, 1936, **3**, 3, 175–195.

[20] Bowen, R. H., *Anat. Rec.*, 1926, **32**, 151–193.

A portion of *Clibanarius* egg showing the various stages mentioned in text.
Nassonov × 1,800

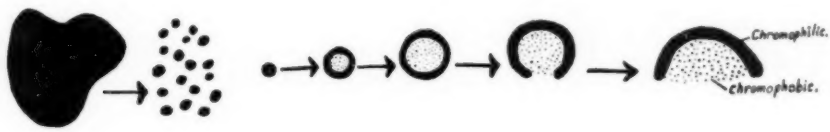


1. Golgi grain. 2. Golgi vesicle. 3. Rupture of vesicle. 4. Batonette.

that I have found between a mass and a typical batonette.

In the eggs of *Clibanarius*[21] and *Stomopneustes*[22] granules, vesicles and batonettes occur side by side at certain stages. But from their order of appearance and from the fact that no case of a *de novo* origin has ever been noted by me or others and also from the occurrence of distinct and unmistakable intermediate stages, I believe it will be interesting if all the stages could be demonstrated in a single photomicrograph and thus the position cleared, in regard to the interrelationship of the various shapes at the same time.

My own conception of the batonette formation is this. The Golgi mass occurring in the earliest oocyte breaks up into a number of granules in which, as in the mass itself, there is no chromophobic component. These granules when they enlarge into vesicles become differentiated into osmiophilic and osmiophobic regions. Rupture of the vesicles takes place resulting in the formation of a



Golgi mass.→ Grains. ⟶ Vesicles. → Rupture of vesicle.→ Batonette.

those found in the various other tissues of the body because it is the Golgi bodies in the eggs which give rise by division and distribution to the Golgi apparatus of all the cells in the body. Hence we are faced with the question how the Golgi bodies having the same origin can be assigned different shapes in different cells. Either the diversity of shape should be accepted or a *de novo* origin of the Golgi apparatus in different cells should be proved. The latter possibility being negligible the only recourse will be to accept the former one. If the diversity of shape is accepted, naturally there should be intermediate stages between the Golgi mass, granules, vesicle, batonette and the network. Leaving the origin of the network for a later communication I shall consider here the nature of the intermediate stages batonette in which the idiosome is in relation with the cytoplasm. In the photomicrograph and the accompanying text-figure my conclusions are given in a pictographic manner.

It is true that such a regular series of stages leading from the Golgi mass to a typical batonette is of rare occurrence and hence extreme caution is necessary in coming to conclusions. It seems that the more one learns about the shape or function of the Golgi bodies, the more evident does it become that its shape or function at first described in many patterns is gradually resolved into numberless variations of a single basic procedure.

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[21] Subramaniam, M. K., *Journ. Roy. Micr. Soc.*, 1935, 12–27.

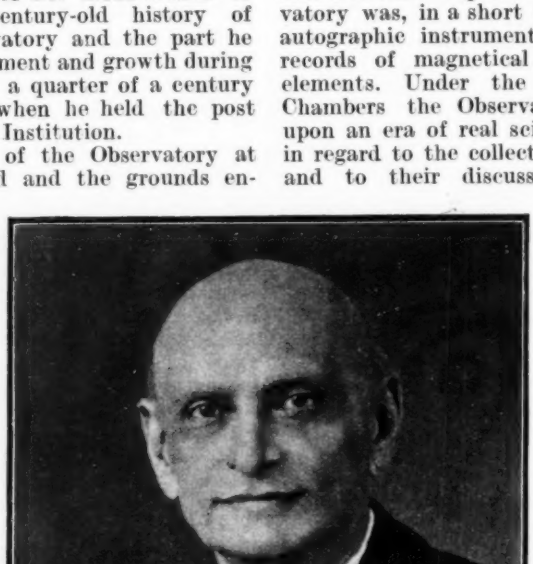
[22] Subramaniam, M. K., and Gopala Aiyar, R., *Zeit. zellf. mikr. Anat.*, 1936, **24**, 4, 576–584.

Obituary.

Dr. N. A. F. Moos, D.Sc., L.C.E., F.R.S.E.

THE recent death of Dr. Moos recalls to memory the century-old history of the Bombay Observatory and the part he played in its development and growth during the period of nearly a quarter of a century from 1896—1919, when he held the post of Director of the Institution.

The present site of the Observatory at Colaba was selected and the grounds enclosed in 1823. In common with many other observatories, the Colaba Observatory began as an Astronomical Observatory. In 1841, magnetical and meteorological work were added to the activities of the institution but it was only from 1846 that the Observatory was properly equipped and began to take regular observations in magnetism and meteorology. Although at first there was a whole-time Astronomer in charge of the Observatory, later the superintendence of the Observatory was carried on as part-time work by a college professor and then by officers in the Royal Navy. In 1864 a Committee was appointed by the Government to enquire into the working of the Observatory and recommend its future programme of work. They recommended, among other things, that for doing useful scientific work a primary necessity was whole-time control by a skilled Superintendent. Except for the work required in connection with the accurate determination of time, it was not considered desirable to have an astronomical programme. In 1865 Mr. Charles Chambers was appointed as the first full-time Superintendent. The Observatory was, in a short time, equipped with autographic instruments giving continuous records of magnetical and meteorological elements. Under the direction of Mr. Chambers the Observatory soon entered upon an era of real scientific activity both in regard to the collection of accurate data and to their discussion. Mr. Chambers contributed a large number of papers (about 32) on the subjects of Terrestrial Magnetism and Meteorology, many of which were published in the *Transactions of the Royal Society*. He also wrote a Memoir on "the Meteorology of the Bombay Presidency".



Dr. N. A. F. Moos, D.Sc., L.C.E., F.R.S.E.

Mr. Charles Chambers, F.R.S., died suddenly in 1896 and Dr. N. A. F. Moos was appointed to succeed him as Director. Dr. Moos worthily upheld the tradition of scientific work established by Mr. Chambers and added to the international reputation of the Observatory. In 1900 the magnetic work of the Observatory was threatened by the proposed introduction of electric traction in the city of Bombay and to preserve the continuity of the long Bombay record it became imperative to shift the magnetic work to a protected site in the neighbourhood. Such a site was secured at Alibagh, about 19 miles to the south-east of Bombay and after the construction of necessary buildings, which include a double-walled constant temperature room, new magnetic instruments were installed and duplicate records for two years at the old and new

sites were secured for comparison purposes before the electric service actually commenced its operations. Like Mr. Chambers, Dr. Moos, in addition to publishing the usual observatory data in periodical volumes, also made a large number of valuable discussions on these and other allied data. His greatest effort however was the publication of two volumes of the work entitled *Colaba Magnetic Data 1846-1905*. The observational material of this remarkable series of magnetic observations extending over 60 years are presented in the first volume and their discussion follows in the second. The reader is at first overwhelmed by the mass of figures in tabular form which are presented for his study but this feeling soon gives place to one of admiration for the enthusiastic perseverance of the author in carrying through such a tremendous piece of work to its conclusion and the thorough manner in which the results are discussed. The volumes form an outstanding contribution to the science of Terrestrial Magnetism and remain a very valuable storehouse of information for students of Terrestrial Magnetism.

Since 1905 magnetic data have now accumulated at the Alibagh Observatory for a further period of 31 years and it is hoped that the India Meteorological Department, which now completely controls the internal as well as the external activities of the two Observatories, will find a suitable opportunity to bring the results and their discussion up-to-date.

Dr. Nanabhai Ardesher Framji Moos was born on the 29th October 1859. He took his degree in Engineering from the Poona College of Science in 1878. Immediately after his graduation he served the Bombay Municipality as an Assistant Head Superintendent of Engineering but finding no attraction in the post he soon joined the staff of his college where he served for five years. Not satisfied with the prospects that were then open to an Indian in the Educational Department he went to Europe for higher education, joined the Edinburgh University and took there in 1886 the degree of Bachelor of Science with distinction. In Edinburgh he won several medals and also the Bursarship of the Highland Society of Scotland; he stood first in the competition examination for the Van-Dunlop Scholarship in Science but as he had not put in the requisite number of terms at the University, could not secure it. The impression he created at the Edinburgh University and the recommendations he carried from Sir W. Muir, the Principal of the University, helped him in securing the acting post of Inspector of Factories on his return to Bombay. Soon after he reverted to his post in Poona College and was thence transferred to the Chair of Physics in Elphinstone College, Bombay. In 1892 he got the substantive post of Inspector of Factories but finding the post uncongenial to his academic and scientific tastes he sacrificed the higher emoluments of the post and returned to his College professorship.

On the death of Mr. Charles Chambers, F.R.S., in 1896 Dr. Moos was appointed Director of Bombay Observatory, a post which he held for 24 years. It falls to the lot of few scientific men to set up new first class observatory but Dr. Moos was fortunate in having two such opportunities in the building up of the New Magnetic Observatory at Alibagh and of the Time Ball Observatory at Karachi.

Dr. Moos' investigational work was mainly directed to the sciences of Terrestrial Magnetism and Seismology as during his tenure of office and in effect since 1888, the work of the Meteorological Reporter at Bombay was placed under the control of the Government of India and was put in charge of the local Superintendent of Telegraphs as a half-time officer.

Dr. Moos held the membership of several scientific societies and was the recipient of many honours. He was a Doctor of Science of Edinburgh University, a Fellow of the Royal Society of Edinburgh, Fellow and Honorary Member of the Highland Society of Scotland and a Fellow of the Chemical Society. Besides doing his official and scientific work, Dr. Moos took a prominent part in the University and civic life of Bombay. He served the Bombay University for a number of years as an examiner, a Fellow of the Syndicate and a Dean of Science. He was a member of the Board of Studies in Engineering and Geology and of the Faculty of Science and the Academic Council. As a member of the Senate he took a keen interest in important educational problems. He was a representative of the University on the Indian Institute of Science, Bangalore, the Engineering College, Poona, and the Prince of Wales Museum, Bombay. As a member of the Bombay Municipal

Corporation representing the University for six years his services were much appreciated. Even after his retirement from official duties in 1919 at the age of 60 years Dr. Moos continued to take a keen interest in meteorological, magnetical and seismological problems. He was always alert and active till he entered rest on 12th March 1936 at the age of 77 years.

The writer of this article was associated with Dr. Moos and his work for 16 years from 1903 to 1919 and cherishes grateful memories of the very kind and paternal interest which he took in his staff in all matters connected with their welfare. He knows Dr. Moos as a fearless exponent of the views which he considered to be right and in the true interests of his beloved Observatory; he knows him also as a keen upholder of his views in his other educational and civic activities and above all as an ideal head of a family and of a working scientific institution.

RAO SAHEB M. V. UNAKAR.

Centenaries in June 1936.

Regiomontanus, Johann, 1436-1476.

JOHANNES MULLER, who is better known by his pseudonym Regiomontanus, was born at Konnigsberg, on June 6, 1436. According to the traditional estimate, Regiomontanus was for long regarded as "the most learned astronomer that Europe had yet produced". He was educated at Vienna. He received the Master's degree in 1457 and became a lecturer the very next year. He lectured on Euclid and on perspective geometry. He also colloborated with his teacher George Peurbach in correcting and revising the Alphonsine Tables.

ADOPTS THE HINDU IDEA OF *Sine*.

In 1462, Cardinal Bessarion persuaded him and his teacher to prepare a Latin translation of Ptolemy's *Almagest*. Peurbach died after translating the first six books and Regiomontanus completed the translation of the remaining seven books. This undertaking took him to Italy where he stayed for six years. While at Italy, he also wrote his Trigonometry entitled *De Triangulis*. This is said to be the earliest modern systematic exposition of trigonometry. He adopts, for the first time, the Hindu *Sine* in place of the Greek *chord of double the arc*. His oration at Padua on the history of mathematics is summarised by Cantor in his *Geschichte der Mathematik*. He is also said to have observed a total eclipse of the moon at Padua on April 2, 1464.

HALLEY'S COMET AND *Ephemerides*.

After being a professor in the University of Pressburg, which was established in 1467, he settled at Nurenburg in 1471, where he had for his pupil and patron a wealthy burgher, Bernhard Wattler, who built an observatory for him. Regiomontanus himself is said to have constructed the necessary instruments for this observatory. It is claimed that his observations of the great Comet of 1472, since called Halley's Comet, supplied the basis of the modern study of comets. His patron established a printing press, from which Regiomontanus issued a series of popular calendars. In 1474, his *Ephermerides* for 1474–1506 was published. This book explained the method of lunar distances for determinining the longitude at sea. Columbus is said to have used a copy of this.

HIS WRITINGS.

In 1475, Pope Sixtus IV invited him to Rome to reform the Calendar. He was made Bishop of Regensburg, but died at Rome on July 6, 1476, while still at the prime of his life. At his death, Regiomontanus left a long list of books, which he had already completed or was at work upon or intended to print for the first time. These included editions or new translations of various mathematical classics, such as the works of Ptolemy, Euclid, Apollonius, Hyginus and Theon. Astrological treatises also figure prominently in the list. Many of them were printed after his death, by his patron Wattler.

S. R. RANGANATHAN.

Coulomb, Charles Augustin, 1736-1806.

COULOMB, the French physicist, was born in Angouleme on June 14, 1736. He studied mathematics and science in Paris and then entered the army. After serving in the West Indies for seven years, he returned to Paris in 1776 and in the thirteen years which followed up to the outbreak of the great Revolution, he carried out his fundamental electric and magnetic investigations.

They brought him recognition and membership of the Academy.

COULOMB'S LAWS.

A good number of electrical and magnetic observations had accumulated for centuries and the additions made to this uncoordinated heap were remarkable during the century that preceded Coulomb. Various attempts had been made to obtain a general and comprehensive view of them and to discover the law of attraction between magnetic poles and between electric charges. But the credit of having enunciated them in exact terms goes to Coulomb. The laws of Coulomb are justly famous both for their simplicity and for the rare masterpiece of experimental skill, which formed their basis.

THE TORSION BALANCE.

The first step towards the discovery of his laws lay in the invention of the torsion balance in 1777. To improve the delicacy of this balance, he investigated the force of torsion and the elasticity of thin metallic and silk fabrics. He found the forces required to twist them to be proportional to the angle of twist, to the fourth power of the diameter of the fibre and to the reciprocal of the length of the fibre but to be independent of the load on the wire. This was published in 1784. With this result as the basis, Coulomb perfected his torsional balance to measure forces which were very small and fleeting. The torsion balance was later used by Cavendish in his important investigation of gravitation. The principle of this balance has since been used in a large number of finest measuring instruments such as galvanometers and electrometers.

HIS OTHER INVESTIGATIONS.

Coulomb was also active in other directions such as the laws of sliding friction and the internal friction of liquids. In the investigation of the latter, which he made in 1801, he made use of the torsional oscillations, executed by cylinders hung up in the liquid.

In 1789, at the outbreak of the Revolution Coulomb resigned all his official posts and retired to his small estate near Blois and devoted himself to scientific research. Napoleon, who had restored order, gave him back his former posts in which he worked devotedly until his death in Paris on August 13, 1806.

S. R. RANGANATHAN.

Ampere, Andre Marie, 1775-1836.

A. M. AMPERE, who was called the Newton of Electricity by Maxwell, was born in Lyons on January 22, 1775. He was brought up alone in the country and his education was got, with a little assistance from his father, mainly through books. He showed a wide range of mental activity and an extraordinary mathematical ability. The beheading of his father in 1793 filled him with apathy and for some time he wandered distracted and planless. His marriage at the age of twenty-four gave his life a definite direction again and he took up a teaching post near Lyons. His wife died within four years after their marriage and this event threw him again into a mood of life-long sadness.

FIRST WORK.

Ampere made his first appearance in the scientific world in a short work entitled *Considerations sur la Theorie Mathematique du Jew*, in which the question of the safety of habitual and indefinite play, either against a single person of greater fortune, or indifferently against any number of persons is discussed in a form full of warning to those by whom gambling is pursued as an occupation. This book brought him recognition and in 1809 he became Professor of Mathematics at the Ecole Polytechnique in Paris. Here he continued his scientific researches with great diligence and published memoirs on the integration of partial differential equations and on other subjects, which show a profound knowledge of some of the most refined and difficult artifices of analysis. The published papers of Ampere number fifty-five, of which three are joint papers.

FATHER OF THE SCIENCE OF ELECTRO-DYNAMICS.

Ampere's fame mainly rests on his memoirs on the mathematical theory of Electric-magnetism, which are remarkable for the skill and ingenuity with which the powers of analysis are brought to bear on subjects apparently the most remote from their operation. Oersted's discovery, in 1820, of the magnetic properties of an electric current decided the direction in which Ampere's gift for scientific research was to develop. Only a few months later, on the

2nd October 1820, Ampere presented to the French Academy of Sciences a paper in which he showed that not only is there a mechanical force between an electric current and a magnet but that there is a mechanical force between two neighbouring electric circuits. This brilliant paper was followed by quite a number of others, in which various details were worked out.

CLARK MAXWELL'S ESTIMATE.

In the words of Clark Maxwell, the whole theory and experiment seems as if it had leaped full grown and full armed, from the brain of the "Newton of electricity". It is perfect in form, and unassailable in accuracy, and it is summed up in a formula from which all the phenomena may be deduced and which must always remain the cardinal formula of electro-dynamics. Ampere's memoirs are a splendid example of scientific style in the statement of a discovery.

HIS PERSONALITY.

Ampere died at Marseilles in June 1836. He was a man of great simplicity of character. He took no part in the cabals and jealousies which too frequently disturb the peace of the world of science. He was universally respected and beloved for his great integrity and the kindness of his affections. He retained a childlike disposition up to his old age. He was often tortured by doubts in small matters as well as great ones, so that life, in spite of all the recognition that it brought him, was by no means always satisfactory, a fact expressed in the epitaph chosen by himself *tandim felix*, *i.e.*, Happy At Last.

S. R. RANGANATHAN.

Award for Scientific Manuscript.

A CASH award of $ 1,000 is offered by the Williams & Wilkins Co., Mt. Royal and Guilford Aves., Baltimore, Md., for the best manuscript on a science subject, presented before July 1, 1937. The publishers put no limitations on the subject-matter or manner of handling, and none on eligibility for the award. The manuscript must be in English and "of a sort calculated to appeal to the taste of the public at large". The desired length is given as 100,000 words.

While any manuscript on a science subject will be considered, it is expected that the author will prove to be a man or woman engaged in a scientific pursuit and who is possessed of the requisite literary skill to interpret science for that portion of the public which reads books.

To assure authority, the publishers have enlisted the services of some 25 or 30 advisers—men of science of wide reputation and assured competence. One or more of these advisers will pass upon each manuscript from the viewpoint of soundness and accuracy. The award will lie in the joint discretion of four judges selected with a view to their especial qualification in choosing the sort of book that will appeal. These are: Joseph Wheeler, Librarian of the Pratt Library in Baltimore, and Chairman of the Book List Committee of the Association for the Advancement of Science; Harry Hansen, Reviewer and Critic for the *New York World-Telegram* and *Harpers Magazine*; Lyman Bryson, Professor of Education of Teachers College, Columbia University, and Director of the "Readability Laboratory"; and David Dietz, Science Editor of the Scripps-Howard newspapers.

Further details concerning the award may be had by addressing the publishers. (News Edition, *Ind. Eng. Chem.*, 1936, **28**, 195.)

Letters to the Editor.

CONTENTS.

	PAGE
The Crystal Structure of Potassium Bicarbonate, $KHCO_3$. By **Jagattaran Dhar**	867
Effect of Temperature on the Raman Spectrum of CCl_4. By **R. Ananthakrishnan**	868
Particle Size and Magnetic Susceptibility. By **Mulk Raj Verma and M. Anwar-ul-Haq**	869
New Bands of Beryllium Oxide. By **N. R. Tawde and V. S. Patankar**	869
Opacity as a General Measure of Coagulation. By **S. S. Joshi and A. Purushotham**	870
Fractionation of Starch. By **B. N. Sastri and A. Krishnamurti**	870
The Origin of Cultivated Tobacco By **Dontcho Kostoff**	872
Cleistogamy in Sorghum. By **G. N. Rangaswami Ayyangar, V. Panduranga Rao and T. Venkataramana Reddy**	872
Cracked Grains in Sorghum. By **G. N. Rangaswami Ayyangar, V. Panduranga Rao and T. Venkataramana Reddy**	874
Chromosome Numbers in Cymbopogon Species (*continued*). By **C. N. Babu**	874
Some More Unrecorded Host-Plants of *Loranthus longiflorus*, Desr. By **R. C. Lacy**	875
English as the Common Language. By **A. Fanti**	876
A Preliminary Survey of Marine Boring Organisms in Cochin Harbour.—A Correction. By **Eileen Whitehead Erlanson**	877

The Crystal Structure of Potassium Bicarbonate, $KHCO_3$.

THE crystal structure of potassium bicarbonate, $KHCO_3$, has been studied by the usual X-ray methods with the help of fixed-film and moving-film cameras. As described in Groth's *Chemische Krystallographie*,[1] the crystal is monoclinic prismatic, with the following elements:—

$a : b : c = 2 \cdot 6770 : 1 : 1 \cdot 3115$; $\beta = 103° 25'$.

Rotation photographs of single crystals of $KHCO_3$ were taken about the three crystallographic axes, in a camera of 5 cm. radius, and the axial lengths were calculated therefrom. Weissenberg photographs about the '*b*' and '*c*' axes were taken in the Seemann goniometer, and analysed by the well-known graphical method.[2] The dimensions of the unit cell are thus found to be

$a = 15 \cdot 01$A, $b = 5 \cdot 69$A, $c = 3 \cdot 68$A;

$\beta = 104° 30'$ (directly measured from Weissenberg photograph).

They correspond to the axial ratios

$$a : b : c = 2 \cdot 64 : 1 : 0 \cdot 647,$$

which agree with Groth's values, except that the '*c*' axial length is halved. Taking the density as 2·17 we have 4 molecules of $KHCO_3$ per unit cell.

Over hundred reflections have been observed. Reflections ($h0l$) are absent if h is odd, and reflections ($0k0$) are absent in odd orders. Consequently the symmetry plane is a glide plane with a translation $a/2$, and the two-fold axis of rotation is a screw axis with a translation $b/2$. It follows therefore that the space group is C_{2h}^5 ($P2_1/a$).

The absence of reflections from ($hl0$) when h is even, and the weak reflections of almost all the planes ($hk0$) when $(h + k)$ is odd, require, that the potassium atom, which is the predominant scatterer, lies practically in the (010) plane. Strong reflections from the planes (400), (401), ($40\bar{1}$), etc., suggest that the CO_3 group should be near the plane (400). Some unpublished data for the magnetic susceptibilities of single crystals of $KHCO_3$ by Asutosh Mookherji of this laboratory also point to the same conclusion. A detailed account will shortly be published elsewhere.

JAGATTARAN DHAR.

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210, Bowbazaar Street,
Calcutta,
June 1, 1936.

[1] **2**, 191.

[2] *Zeit. f. Kryst.* (A), 1933, **84**, 327.

Effect of Temperature on the Raman Spectrum of CCl_4.

I HAVE investigated the Raman spectrum of liquid CCl_4 over a wide range of temperatures extending from the room temperature up to 200° C. Rise of temperature brings about several progressive and striking changes in the Raman spectrum of this substance, as can be seen from the photograph reproduced below.

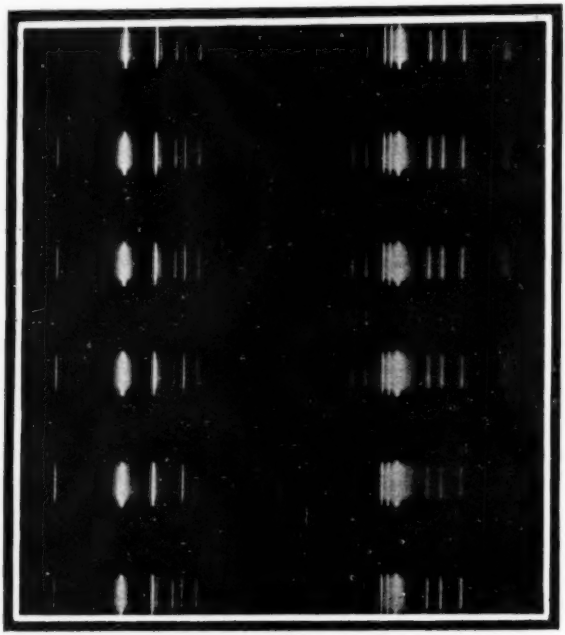

Fig. 1.

(1) The doubly degenerate Raman line at 218 cm.$^{-1}$ and the triply degenerate frequency at 314 cm.$^{-1}$ become considerably broad and diffuse as the temperature is elevated.

(2) The pair of Raman lines at 762 cm.$^{-1}$ and 790 cm.$^{-1}$ forming the triply degenerate frequency, which are very well resolved at the ordinary temperature become rapidly diffuse as the liquid is heated.[1] In the spectrum photographed at 200° C. these lines have merged into one another into a single broad and diffuse band.

(3) The totally symmetric vibrational Raman line at 459 cm.$^{-1}$ does not seem to be appreciably influenced by temperature.

(4) In the Raman spectrum of the liquid at 200° C. the Stokes lines are markedly weaker than those at room temperature. This observation is in contradiction to Placzek's theory which predicts an increase of intensity for the Stokes as well as the anti-Stokes components with rise of temperature. It also appears that the increase in intensity of the anti-Stokes components, if any, is much less than that demanded by the theory.

The increased width and diffuseness of the degenerate vibrations is presumably connected with the greater rotational freedom of the molecules at higher temperatures. The reason for the fall of intensity of the Stokes components with rise of temperature is in all probability due to diminution of $\left(\frac{\partial \alpha}{\partial q}\right)_0$ for the higher vibrational states whose population is more dense at higher temperatures. The full significance of the results will be discussed in detail in a paper which will shortly appear in the *Proceedings of the Indian Academy of Sciences*.

R. ANANTHAKRISHNAN.
Department of Physics,
Indian Institute of Science,
Bangalore,
June 5, 1936.

[1] See Fujioka, *Sci. Pap. Inst. Phys. Chem. Res., Tokyo*, 1929, **11**, 222.

Particle Size and Magnetic Susceptibility.

COPPER powder of particle size $0 \cdot 4\mu$ was prepared by displacement from copper sulphate by extra pure zinc followed by treatment with hydrochloric acid and fractionation. Copper powder was also prepared by electrodeposition at high current densities. The value of the mass magnetic susceptibility of the two samples was found to be $-0 \cdot 82 \times 10^{-7}$ which is the normal value for copper.

Rao[1] has prepared copper coagula by sparking between copper electrodes in a medium of propyl alcohol or benzene and concludes from his measurements that the diamagnetic susceptibility of this metal is size-dependent, the value increasing with the decreasing particle size. Although Rao started with a sample of copper of 99·964 per cent. purity, an analysis of the resulting coagula was desirable, for the present authors find that a considerable quantity of carbon is included in the coagulum obtained by the above method. Very probably this inclusion is responsible for Rao's results.

The authors have also carried out the susceptibility measurements with lead powders prepared by a variety of methods. The values of magnetic susceptibility measurements are given in the table below after the powders had been washed free from the oxide or other impurities.

	$\times 10^{-7}$
Lead metal	−1·22
Lead powder (0·4 to 0·6μ) (mechanical grinding)	−1·23
Lead powder (displacement from lead acetate by magnesium) ..	−1·22
Lead powder (cathodic pulverisation)	−1·22

From these experiments it is concluded that there is no effect of particle size on the magnetic susceptibility in the case of copper or lead. Similar results are to be expected in the case of the rest of the elements provided no change is brought about in the crystalline structure during powdering or colloidalisation.

Full details will be published elsewhere.

MULK RAJ VERMA.
M. ANWAR-UL-HAQ.
University Chemical Laboratories,
Lahore,
May 28, 1936.

[1] *Proc. Ind. Acad. Sci.*, 1935, **2**, 249.

New Bands of Beryllium Oxide.

WHILE looking out for a new band system of BeF molecule in the near infra-red, we photographed the spectrum of carbon arc in air fed with powdered potassium beryllium-fluoride. Two moderately intense bands in the region 8500–10000 Å degraded to further infra-red were recorded on our plates. On identification, it was found that these bands could not be attributed to the BeF molecule. By introducing beryllium oxide instead of potassium beryllium-fluoride in the lower electrode of the carbon arc these bands were recorded with still greater intensity. This led us to make a search for any of the band systems of BeO molecule. Looking for the latest references on the subject, we found that the red system $^1\pi \rightarrow {}^1\Sigma$ which Herzberg[1] has analysed is deficient in sequences $v' - v'' = +1, 0, -1$, etc., and these evidently must lie above 8204 Å, the limit to which Herzberg has recorded his bands.

In view of the above, we made accurate measurements of wave-lengths by photographing the bands on Kodak IIIQ and Agfa Infra-red plates by means of Hilger's infra-red glass-prism instrument with a dispersion of about 125 A.U. per mm. at 8700 Å and 150 A.U. at 9600 Å. The heads of the new bands were found to have wave-lengths 8710·17 and 9641·9 Å with a possible error of ± 1 A.U. Using Herzberg's zero-line (band origin) equation for $^1\pi \rightarrow {}^1\Sigma$ system, we could tentatively assign the following vibrational quantum numbers to these bands in this system:

Band at	Intensity	v', v''	Observed ν_h	Calculated ν_0 (Herzberg)
9641·9 ..	10	0,0	10368·54	10364·17
8710·17 ..	4	1,0	11477·67	11475·14

From the fact that these bands could only be obtained in the outer flame when BeO salt is excited in the arc and appear along with and similar to the existing bands of the infra-red system, makes us believe that these bands are probably due to BeO molecule. A revised vibrational analysis of the whole system along with the new bands is proceeding.

Royal Institute of Science, N. R. TAWDE.
Bombay, V. S. PATANKAR.
May 15, 1936.

[1] L. Herzberg, *Zeit. f. Phys.*, 1933, **84**, 571.

Opacity as a General Measure of Coagulation.

IN the course of a work to be published shortly in the *Indian Chemical Journal*, it has been observed that the *opacity* of manganese dioxide sol increased '*zonally*,' that is, with marked discontinuities, during coagulation, and that this feature became more pronounced the *slower* the coagulation. The curves in Fig. 1 represent but three typical cases observed during *subsequent* work on the

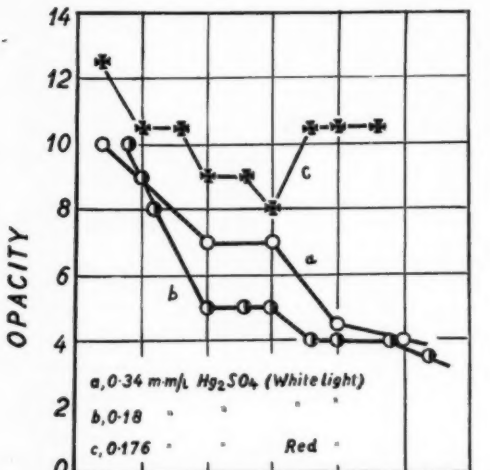

Fig. 1.

kinetics of the same sol, but using a higher colloid content and with solutions of mercurous sulphate as coagulants. These results not only confirm the '*zonal*' change of opacity during coagulation, but show, contrary to expectation from the current theories and general experience, that the opacity has *decreased* during the change. As is usual in these kinetic studies, measurement of the opacity during coagulation was discontinued, as soon as the coagulating system became heterogeneous by flocculation, that is, produced discrete particles of the coagulum sensibly subject to local variations. Curves *a* and *b* refer to experiments made with the white light from a glowing filament; these show that the opacity diminishes with coagulation. Partly different results were noticed when a narrow band, almost monochromatic near H*a*, was employed. Curve *c* is one of the results. It shows that there is an initial diminution of opacity followed by a rise, and that both the stages of the change are marked by the '*zonal effect*'. It has been almost a tacit assumption with colloid chemists that coagulation entails an increase of opacity; the adoption of the last quantity as a measure of the degree of coagulation has had a wide and long usage in the field of coagulation kinetics. It is of considerable interest, therefore, to observe, it would appear for the first time in this line, not only a limitation of the general validity of the above assumption, but of the possibly general discontinuous character of the change, independent of whether opacity and coagulation vary in the same sense or otherwise, as was also noticed previously in respect of changes of viscosity and refractive index, during coagulation.[1]

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Department of Chemistry,
Benares Hindu University,
Benares,
May 14, 1936.

[1] Joshi and Rao, *Curr. Sci.*, 1936, **4**, 481; also *J. Indian Chem. Soc.*, 1936, **13**, 141.

Fractionation of Starch.

A SURVEY of the literature on amylolysis in relation to the structure of starch reveals the existence of two contradictory views supporting either the homo- or heteromolecular nature of starch. A study of the mutarotation phenomena accompanying the hydrolysis of starch with different amylases led Kuhn[1] to the view that the starch molecule consisted of both α- and β-glycosidic linkages which were specifically attacked by α- and β-amylases; the sense of the mutarotation was independent of the substrate but was characteristic of the enzyme. van Klinkenberg[2] from his work on the action of integrally pure β-amylase on starch, which hydrolysed a definite fraction (64 per cent.) of the starch substance, advanced the view that the liberation of the α- and β-maltose was not due to the alternative types of hydrolysis of a single substrate, but rather, to the specific hydrolysis of different components of starch which he designated α- and β-starches. A critical examination of the question by Hanes[3] has revealed that, while the main conclusions of van Klinkenberg can be confirmed, no

evidence exists to show that the two components pre-exist in the starch substrate, the possibility of their being fragments of a single molecule not having been disproved. Indeed, the recent work of Freeman and Hopkins[4] has led the authors to reject the hypothesis that starch is composite. Our results on the fractionation of starch furnish some evidence on this question.

A 10 per cent. solution of soluble starch (Riedel-E de Haën A-G., A.R., according to Zulkowski) in 30 per cent. solution of calcium chloride was employed for the fractionation of starch. Absolute alcohol was gradually added to the solution under vigorous stirring to a concentration of 20 per cent.; the precipitate obtained was centrifuged and washed three times with a calcium chloride-alcohol mixture of the same composition as that of the mother liquor. The alcohol concentration of the centrifugate was then raised to 50 per cent. when a further quantity of precipitate was obtained. This was separated and treated in the same way as the first precipitate. A further amount of alcohol was added to the centrifugate to raise the proportion of salt solution to alcohol to 1 : 10. The precipitate was separated and washed. The three fractions were repeatedly washed with alcohol and finally extracted in a Soxhlet with absolute alcohol to remove the last traces of the salt.

The specific rotations of the fractions are tabulated below :—

TABLE I.

	Fraction I	Fraction II	Fraction III
$[\alpha]_D$	169·1	170·5	176·7

The three fractions give different colourations with iodine: thus, Fraction I gives a blue colour and Fraction III a reddish colour with hardly any blue in it; the colour given by Fraction II lies between the two. The three fractions are hydrolysed at different rates by Taka diastase and β-amylase prepared from ungerminated barley. The results obtained with β-amylase employing the same quantities of enzyme and starch are graphically represented (Fig. 1).

The difference between the rates of hydrolysis of Fractions I and III is striking. The quantity of starch hydrolysed in 30 minutes from the three fractions which may be taken

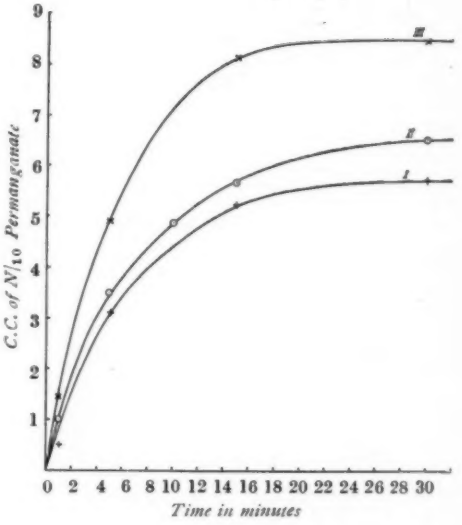

Fig. 1.

Starch 1·0 per cent.; β-amylase 0·5 per cent.

50 c.c. of starch + 10 c.c. of McIlvin's Buffer (pH, 4·8) + 10 c.c. of β-amylase.

10 c.c. used for the estimation of Maltose (Bertrand).

as an indication of their β-amylose contents, are respectively

0·5897; 0·6414; 0·8713 grams.

The results clearly show that by a process of solution and precipitation it is possible to fractionate soluble starch into two components differing with respect to their colour reactions with iodine and β-amylose contents. It can be reasonably assumed that the procedure adopted to effect the fractionation does not bring about any chemical change in the starch, and the conclusion that starch is composite and that the components pre-exist in the starch substance, therefore, appears justified.

Further work on the other characteristics of the fractions is in progress.

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A. KRISHNAMURTI.

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June 10, 1936.

1 Kuhn, *Liebigs' Ann.*, 1925, **443**, 1.
2 van Klinkenberg, *Ergebnisse Enzyme forsch*, 1934, **3**, 73.
3 Hanes, *Can. J. Res.*, 1935, **13B**, 185.
4 Freeman and Hopkins, *Biochem. J.*, 1936, **30**, 451.

The Origin of Cultivated Tobacco.

THE cytogenetic investigations during the last few years supplied evidences for the origin of *Nicotiana tabacum* L. (cigarette and cigar tobacco) and of *Nicotiana rustica* L. (pipe tobacco, Makhorka). Both species represent allopolyploid hybrids, the former being an amphidiploid of *Nicotiana sylvestris* and *Nicotiana tomentosiformis* (syn. *Rusbyi*) or a form of the tomentosa group, while the latter being an amphidiploid of *N. paniculata* and *N. undulata*. *N. tabacum* and *N. rustica* have 48 chromosomes in the somatic cells, while *N. sylvestris*, *N. tomentosiformis*, *N. paniculata* and *N. undulata* have 24 chromosomes in the somatic cells.

The arguments for the above statements are:

1. *For N. tabacum.*—*N. tabacum* haploids have most frequently 24 univalent chromosomes during the first meiotic division, though one or two bivalents also occur. The same chromosome behaviour often occurs in the F_1 hybrids *N. sylvestris* × *N. tomentosiformis*. In the hybrids *N. tabacum* × *N. sylvestris* 12 chromosomes of *N. tabacum* conjugate with the chromosomes of *sylvestris*. The same mode of conjugation was found in the hybrid *N. tabacum* × *N. tomentosiformis*, *i.e.*, 12 bivalents and 12 univalents. The production of triple hybrids with 24 bivalents in crossing *N. tabacum* with the F_1 (*sylvestris* × *tomentosiformis*), *i.e.*, a fully fertile triple hybrid having all three complete genoms of the component species supplied the evidence that 12 *tabacum* chromosomes are homologous with the chromosomes of *sylvestris* while the other 12 are homologous with those of *tomentosiformis*. The production of the amphidiploid *sylvestris-tomentosiformis*, however, represented the final solution of the problem. The amphidiploid *sylvestris-tomentosiformis* has 48 somatic chromosomes. It produces fully fertile hybrids with *N. tabacum*, and has morphological characters the varieties of *N. tabacum* have.

2. *For N. rustica.*—*N. rustica* haploid has usually 24 univalent chromosomes and rarely bivalents are formed, while in the hybrid *paniculata* × *undulata* non, or several bivalents are formed. F_1 hybrids *N. rustica* × *N. paniculata* and *N. rustica* × *N. undulata* form usually 12 bivalents and 12 univalents during the first meiosis (occasionally trivalents are formed too, but this is in agreement with the former data). Trigenomal triple hybrid *N. rustica* × *paniculata* × *undulata* (having complete genoms from all these three species, *i.e.*, 48 chromosomes) should be fertile as well as the amphidiploid *undulata-paniculata*. The hybrids between *rustica* and the amphidiploid *paniculata-undulata* should be fertile too. This phylogenetic problem has such a direction of development. It is outlined here very roughly and will be given elsewhere in detail.

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Moscow,
May 23, 1936.

Cleistogamy in Sorghum.

CLEISTOGAMY occurs in many grasses. In wild species of *Hordeum* (Barley) cleistogamic forms have been noted. In cereals the occurrence of cleistogamy is very rare. The economic disabilities attendant on seed production under cleistogamic conditions militate against the common occurrence of cleistogamy in cereals; the more so in the case of sorghum in which the grains are naked and develop beyond the glume. In the wide collection of sorghums under study at the Millets Breeding Station, Coimbatore, two races, one Indian and another African, have been met with in which the flowers are cleistogamous. These races belong to the botanical group *Sorghum papyrascens*, Stapf., the very group in which erratic flowering,[1] vivipary,[2] and chlorophyll deficiencies[3] have been recorded. The long papery glumes and the degenerate lodicules have already been noted to be responsible for the erratic flowering.[1] In the cleistogamous forms, the earheads never give such evidences of flowering as the presence of stray emerged anthers and odd protruding stigmas. Such pedicelled spikelets as were antheriferous remained unopened. In spite of this the chaffy-looking heads did give a few viable grains. An examination was made of the cleistogamic forms in comparison with chasmogamic ones among the *papyrascens* group of sorghums. The following tabular statement brings out the points of contrast.

The cause of the cleistogamy will be evident from the accompanying table. In the cleistogamic forms the involucral glumes are big. The lower floral glume is very wide and clasps the upper floral glume (lemma) tightly. This clasp coupled with the degenerated scaly lodicules results in cleistogamy.

Sorghum papyrascens, *Stapf. Spikelet Measurements (Average of 12).*

	Chasmogamic form mm.	Cleistogamic form mm.
	L. B.	L. B.
Lower Involucral glume	7·0 × 4·0 (5·5 spread out)	9·5 × 4·5 (6·0 spread out)
Upper Involucral glume	6·7 × 3·6 (5·0 spread out)	9·5 × 3·5 (5·5 spread out)
Lower Floral glume	5·0 × 3·0 (4·0 spread out)	5·5 × 2·7 (4·2 spread out)
Upper Floral glume	4·5 × 3·5	4·5 × 3·5
Anthers	4·2 × 1·2	3·5 × 1·0
Filamental length	6·0 to10·0	4·0 to 6·0 (coiled)
Lodicules	2·3 × 1·5 × 1·0 (thickness)	1·1 × 0·6 × 0·4 (thickness)

Examinations made on spikelets at various hours of the night showed that between 3 and 5 a.m. there is a feeble endeavour on the part of the two involucral glumes to open out a bit, only to close up enclosing the clasped floral glumes with the anthers and ovary inside them. The smallness in the size of the anthers and the shortness in the length of the filaments (which become coiled) is noteworthy. In a dissected flower the anthers are stuck up against the stigmatic feathers and pollinate them after dehiscence (Fig. 1). In the spikelets in which the grains

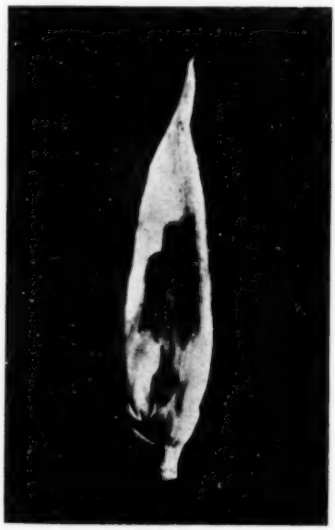

Fig. 1.

set, the shrivelled stigmas, anthers and filaments stuck up between the developed grain and the triangular niche above it, are easily noticeable (Fig. 2).

Earheads in which this cleistogamy occurred were analysed and compared with

Fig. 2.

related chasmogamic lines and the following table brings out the points of contrast between the two.

Sorghum papyrascens, *Stapf.*

Earhead Analysis (Average of 6 Heads).

	Chasmogamic heads	Cleistogamic heads
Percentage of—		
1. Fertile sessile spikelets	59	50
2. Ill-developed seeds (¼ weight of normal)	5	19
3. Viviparous seeds	9	15
4. Antheriferous pedicelled spikelets	0	17

In cleistogamic heads the relatively poorer seed setting is evident. The accentuated vivipary is noteworthy. Above all the remarkable activation under this abnormality of as many as 17 per cent. of the usually abortive pedicelled spikelets into antheriferous ones,[4] throws interesting evidence on the probability of these pedicelled spikelets having once had perfect flowers.

G. N. RANGASWAMI AYYANGAR.
V. PANDURANGA RAO.
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Millets Breeding Station,
Coimbatore,
April 11, 1936.

[1] *Jour. Indian Bot. Soc.*, 1936, **15**, 139-142.
[2] *Curr. Sci.*, 1935, **3**, 617.
[3] *Indian Jour. Agr. Sci.*, 1932, **2**, 266.
[4] *Indian Jour. Agr. Sci.*, 1931, **1**, 452.

Cracked Grains in Sorghum.

IN Gramineæ, the rôle of the pericarp in the protection of the endosperm and the embryo is obvious. Any disturbance to this pericarp is deleterious to the seed. In Maize, Zapparoli[1] records the occurrence and inheritance of broken grains. In the grain sorghum which develops its naked grains outside the glumes, the importance of a sound and whole pericarp is obvious. At the Millets Breeding Station, Coimbatore, cracked grains in sorghum have been met with in half a dozen African races. They occurred in *Sorghum caffrorum*, Beauv., *S. caudatum*, Stapf., *S. rotundulum*, Stapf., and *S. guineense*, Stapf. In two races the cracking occurred in practically every grain of the earhead and in the others was found to be anything from 20 per cent. upward. Seasonal variations affected the degrees of expression. The cracked grains show best in the dough stage. Cracking commences with a longitudinal slit in the pericarp which deepens into a regular cleft with the rapid development of the grain, exposing the markedly noticeable white starch in the cleft. In purple pigmented varieties, these rents in the pericarp stimulate the usual run of pigment which gets deposited at the edges of the cleft and colours up the cracked areas. Cracking commences in the grains at the top of the panicle and covers the whole of it, in about a week's time. The cracks are very noticeable in round plumpy grains. They may be one, two, or three in number (see photo). They are disposed towards the embryo side of the grain and run roughly along the watermark lines clearly observable in some varieties. Cracking has so far been noted only in chalky grains[2] with a comparatively soft endosperm. In the flattish grains of *S. guineense* capped as they are with a partly corneous endosperm, the cracking is very irregular and erratic in disposition. In every one of these races, the markedly bold grain (big relatively to the grain size usually associated with the respective varieties), was a noticeable feature. In the earheads in which there were both cracked and uncracked grains, the average weight of cracked grains was about 6 to 7 per cent. more than the uncracked ones. Selections taken for cracking have bred true. The behaviour of this character in inheritance in crosses with normal grains is under study.

Cracked Grains in Sorghum.

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V. PANDURANGA RAO.
T. VENKATARAMANA REDDY.

Millets Breeding Station,
Coimbatore,
April 12, 1936.

[1] *Jour. Herd.*, 1925, **16**, 259-262.
[2] *Indian Jour. Agr. Sci.*, 1934, **4**, 96-99.

Chromosome Numbers in Cymbopogon Species (*continued*).

IN a previous communication,[1] the chromosome numbers of five species were recorded. The numbers of the remaining South Indian

species and the numbers previously omitted are given in the present note.

Name of Species.	$2n$	n
Cymbopogon polyneuros, Stapf. ..	20	10^2
C. Cæsius, Stapf. ..	22	11^2
C. flexuosus, Wats. (Variety from Kallar) ..	20	10
C. Nardus, Tendle ..	20	..
C. Martini, Wats. ..	40	20
C. coloratus, Stapf. ..	40^2	20
C. citratus, Stapf. ..	60	..

My thanks are due to Mr. K. Cherian Jacob of the Madras Herbarium, Agricultural Research Institute, Coimbatore, who kindly identified the different species and also supplied some of the material used in the present study.

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Lawley Road P. O., Coimbatore,
May 19, 1936.

[1] *Curr. Sci.*, 1936, **4**, No. 10, 739-40.
[2] Already reported.

Some More Unrecorded Host-Plants of *Loranthus longiflorus*, Desr.

WITH reference to the articles published by Mr. G. D. Srivastava[1] and Messrs. Sayeeduddin and Salam,[2] there may be added some more Host-Plants of *Loranthus longiflorus*, Desr. which have been found to occur in the neighbourhood of Patna. Fischer[3] has given a fairly comprehensive list of the various species of *Loranthus* and their host-plants as he found them in Southern India. There is no such record for the Northern part of the country. Various authors have made casual reference and mention of *Loranthus* and its hosts. If the botanists in various parts of the country could report the hosts and the parasites after proper identification, it could be summarised and an All-India list could easily be prepared which will certainly throw more light to understand this baffling parasite and its mode of parasitism.

Haines[4] has recorded four species of *Loranthus* in the province of Bihar and Orissa, *viz.*, *L. longiflorus*, *L. globosus*, *L. scurrula* and *L. cordifolius*. In the month of February ripe berries of *L. longiflorus* were collected. The skin was removed and they were fixed by their viscin on the stem of various plants. The seeds germinated in about a month, sending out a pair of leaves and fixing firmly to the host by the haustoria. Various plants were tried as hosts without any special discrimination. The dry wind which started and continued for a week during the beginning of March, did effect most seeds, but many seeds germinated and took hold of their hosts in the usual way. In case of *Ficus glomerata* and *Ficus carica*, all the seeds germinated successfully and seemed to flourish very well. It may be due to the juicy and milky nature of the bark which allowed enough facilities to effect the hold on the host (Fig. 1).

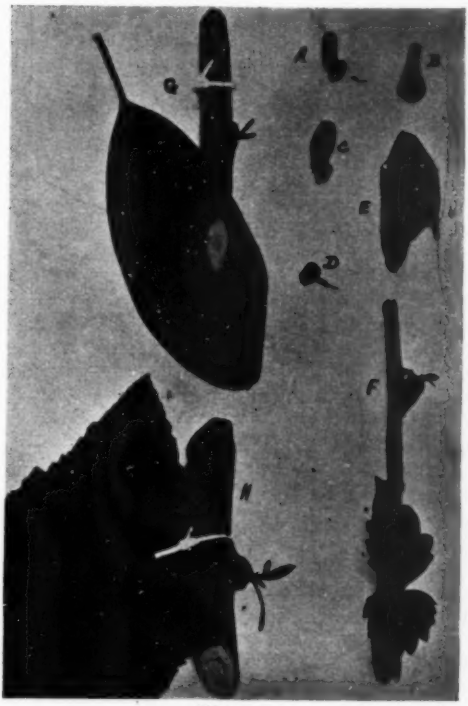

Fig. 1.

A—H.—Showing the various stages in the germination of the seeds of *L. longiflorus* on different hosts.

The hosts were recorded at various times of the year but the species of the parasite was ascertained during the flowering season. Round about Patna, only *L. longiflorus* abounds. Evidently there appear no specialisation of hosts with this parasite, it seems that there is more or less a chance of transfer of the seeds at the right place which is helped by climatic conditions. Of course the shedding of the bark plays an

important part as it was noticed in the case of Eucalyptus. The seeds were put on the tree after making a slight incision in the bark in the beginning of March. They started germinating, but the tree completely shed its bark from top to bottom in the end of the month. Consequently the seeds were thrown off.

It was also noticed that seeds which were put on the western side of the stem in most cases did not survive the hot winds blowing from west to east, while a marked difference was noticed in the seeds on the eastern side which got some protection from these scorching winds.

From the long list given by Fischer,[3] one can see the heterogeneous types of hosts. One is forced to conclude the laxity of this parasite in selecting its hosts, which are again governed by other factors, *e.g.*, climatic and chance.

The following hosts of *Loranthus longiflorus*, Desr. have been recorded in Patna so far. The first 15, to my knowledge, have not been recorded so far. Mango and Shisham seem to be very badly infested with this parasite. *Aegle Marmelos* and *Terminalia Catappa* have been reported as host plants of *Loranthus* from the Royal Botanical Garden in Calcutta by Scott, but the species of the parasite is not mentioned. Similarly, *Rosa* species is reported from Ootacamund Botanic Gardens by Biddie without the specific parasite.

Thanks are due to Prof. S. S. Choudhury for drawing my attention to the parasite on *Sesbania ægyptica*, var. *bicolor* in the College Botanical Garden.

(1) *Aegle Marmelos*, (2) *Ficus infectoria*, (3) *Swietenia macrophylla*, (4) *Cassia fistula*, (5) *Thevitia neirifolia*, (6) *Sesbania ægyptica*, var. *bicolor*, (7) *Morus indica*, (8) *Codiæum variegatum*....'Croton', (9) *Grevillea robusta*, (10) *Cordia myxa*, (11) *Terminalia Catappa*, (12) *Cedrela Toona*, (13) *Rosa* sp., (14) *Bauhinia variegata*, (15) *Premna mucronata*, (16) *Wrightia tomentosa*, (17) *Mangifera indica*, (18) *Melia azedarach*, (19) *Psidium guayava*, (20) *Ficus religiosa*, (21) *Dalbergia sisso*, (22) *Albizzia labbek*, (23) *Callistemon linearis*, (24) *Casuarina equisetifolia*, (25) *Acacia auriculæformis*, (26) *Tectona grandis*, (27) *Bombax malabaricum*, (28) *Punica granatum*, (29) *Pongamia glabra*.

From the list given above one can easily see that a large number of these hosts have not yet been recorded. Nos. 16 to 29 have been found to occur here, but they have been recorded by various observers at other places in India.

R. C. LACY.

Biology Department,
P. W. Medical College,
Patna, Bihar,
May 14, 1936.

[1] Srivastava, G. D., *Curr. Sci.*, 1935, **4**, 106.
[2] Sayeed-uddin and Salam, *Curr. Sci.*, 1935, **4**, 162.
[3] Fischer, C. E. C., *Rec. Bot. Survey of India*, 1926, **11**, No. 1.
[4] Haines, H. H., *Bot. of B. & O.*, Part V, 119.

English as the Common Language.

ONLY recently have I seen your article "English as the Common Language of India" in the November 1935 issue of your *Journal*[1] and note that in it there is no reference to the general question of an International auxiliary language.

Many individuals and institutions have given much thought to this problem, but most agree that a so-called natural language is out of the question.

Amongst the activities in this field in English-speaking countries the following may be mentioned.

The American Philosophical Society appointed a Committee whose report was published in their *Proceedings*[2] and reproduced in *Nature*.[3]

A British Association Committee submitted a report published in 1921 (*B. A. Report*, pp. 390-407) and stated "an invented language is best. Esperanto and Ido are suitable: but the Committee is not prepared to decide between the two".

In 1918 the (British) Prime Minister's Committee on Modern Languages recommended....that a Committee be appointed to inquire into the potentialities of artificial languages and of the desirability of encouraging the development and use of one (quoted in *B. A. Report* referred to above).

The International Auxiliary Language Association founded some years ago in New York is still carrying on research work.

'*Nature*' has more than once voiced the desirability of such a language. In its number for October 16, 1926,[4] it states that "of the artificial languages now current, only Esperanto, its off-shoot Ido and Interlingua (Latin without inflexions) are of serious importance". To these perhaps may be added now "Novial" of Prof. Jespersen. Latin with inflexions is supported in Germany by "Societas latina"; in the U. S. by Prof.

Roland G. Kent of the University of Pennsylvania and by others.

About Interlingua Prof. F. G. Donnan, in his lecture at the Royal Institution of Great Britain, published in its *Proceedings*,[5] states: "the man who has defined most clearly the Neo-Latin principle and who has not only worked the hardest in this field, but also grouped and organised many isolated workers of kindred views and affiliations is (the late) Dr. G. Peano..... Following the indication given by Leibniz, Peano built on an exclusive Neo-Latin basis so far as the main vocabulary is concerned, though modern words acquiring international usage may be accepted. Partly as the result of Leibniz's views, and partly on the basis of his own reasoning, he has eliminated from grammar formal gender, declension, number and even conjugation of the verb.. the result is his Latino sine flexione" or Interlingua. According to the statement of Prof. J. L. Gerig of Columbia University, New York, Interlingua is the only one (of the International languages) that is making any real headway (*Americana Annual*, 1933: art. Philology).

Of all countries it would seem that India with so many very important vernaculars should have a large number of people interested in the problem of an International auxiliary language. In connection with the use of English there is a very interesting article by Kilne O. Moe in *Mid-Pacific Magazine*[6]; in it is stated that the "Filipino English is in a class by itself....evolved but of many painful attempts to find a common medium". The author asks the question "Will the English language survive in the Philippines?" and the answer is not an unqualified yes.

Information about Interlingua may be had from Prof. N. Mastropaolo, Editor of *Schola et vita*,* organ of the Academia pro-Interlingua, which is carrying on its work from the time of Volapuk. It may be added that a very extensive Interlingua-English and English-Interlingua vocabulary, larger perhaps than any of the other International languages, is very nearly completed, and it is hoped to find funds for its printing.

A. FANTI.

c/o National Bureau of Standards,
Washington, D. C., U.S.A.,
May 10, 1936.

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[1] *Curr. Sci.*, 1935, **4**, 296.
[2] 1888, **25**.
[3] *Nature*, **38**, 351-355.
[4] *Nature*, 1926, **118**, 543.
[5] 1920-22, **23**, 546.
[6] *Mid-Pacific Magazine* for Jan.-March, 1936, pp. 28-31.
* Address of "Schola et vita": Viale Berengario, 19, Milano, Italy.

A Preliminary Survey of Marine Boring Organisms in Cochin Harbour.—A Correction.

LAST October I sent some specimens of Sphæromidæ to the British Museum for identification, which were determined as *Sphæroma terebrans* Bate and *S. annandalei* Stebbing by Dr. I. Gordon, tentatively. Some of the material was sent to Dr. Monod of Paris, who is the chief authority in this group of Isopods. I have recently received a report of Dr. Monod's identifications which necessitate a correction in my paper on Marine Borers in Cochin Harbour.[1]

Dr. Monod is of opinion that the material must be referred to *Sphæroma vastator* Sp. Bate. He would retain *S. vastator* as distinct from *S. terebrans*, the former an Indian Ocean (and probably South African), the other an Atlantic, form. He also says, moreover, that as to *S. annandalei* he cannot see how it differs from *S. vastator*[2]; and would find it exceedingly difficult to separate the two.

EILEEN WHITEHEAD ERLANSON.

Madras,
June 9, 1936.

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[1] *Curr. Sci.*, 1936, **4**, 726-732.
[2] Extract from a personal communication from Dr. Gordon.

Research Notes.

New Data on Isotopes.

SINCE the binding energies of nuclei can be estimated from their mass defects, the importance of accurate values of the atomic weights of the isotopes of elements need not be laboured. Great interest therefore attaches to the new work of Aston with his improved new mass-spectrograph. His values for the atomic weights of the proton, the neutron, helium and carbon have already been quoted in these columns. In *Nature*, 1936, **137**, 613, he has reported the results of new measurements carried out by him. Great accuracy has been obtained by comparing pairs of particles of almost the same mass—the so-called doublets such as N, CH_2; F, HDO; Ne, D_2O etc. The following are his results:—

Symbol	Packing Fraction	Isotopic Weight
^{10}B	16·1	10·0161 ± 0·0003
^{14}N	5·28	14·0073 ± 0·0005
^{19}F	2·36	19·0045 ± 0·0006
^{20}Ne	−0·70	19·9986 ± 0·0006
^{27}Al	−3·3	26·9909
^{28}Si	−5·0	27·9860
^{29}Si	−4·7	28·9864 ± 0·0008
^{40}A	−6·15	39·9754 ± 0·0014

He has also revised the isotopic constitution which he had previously given in the case of a few elements. These are:

Cd:	Mass numbers	106	108	110	111	112	113	114	116		
	Abundance	1·5	1·0	15·6	15·2	22·0	14·7	24·0	6·0		
Sn:	Mass numbers	112	114	115	116	117	118	119	120	122	124
	Abundance	1·1	0·8	0·4	15·5	9·1	22·5	9·8	28·5	5·5	6·8
Pb:	Mass numbers	204	206	207	208						
	Abundance	1·0	28·3	20·1	50·1						

The other previously given isotopes of Pb are regarded as doubtful.

He considers that Fe 58 and Ni 64 found by Zeeman and de Gier by the parabola method no doubt exist, whereas Ni 61 observed by them seems to present a conflict with his own results. He also regards that Nd 148 and 150 recorded by Dempster are real isotopes, in which case, as he points out, the discrepancy between the chemical atomic weight and the mass spectrograph value may disappear.

T. S. S.

Thixotropic Gels.

GELS which can be converted into sols by applying a suitable mechanical stress, *e.g.*, by shaking, and set to gels again at a definite rate when the stress is removed are known as thixotropic gels. The actual transition in such a system from sol to gel or *vice versa* is not in general accompanied by a change in volume, and the average distance between the constituent particles must therefore be the same in the sol and the gel. Under the circumstances it is interesting to enquire how the rigidity has developed in a previously fluid sol. A widely accepted explanation is that the particles in the gel are surrounded by thick envelopes of oriented water molecules or "lyospheres", and that these envelopes are destroyed by shaking, and reform on allowing to stand. When these spheres are large enough to make contact with each other the sol becomes rigid. Such an explanation is however not very convincing, and in the May number of the *Proceedings of the Royal Society*, J. L. Russel and E. K. Rideal have advanced an alternative theory that thixotropic gelation is due to oriented coagulation of the highly dispersed anisotropic material which is usually contained in such gel materials. In such a sol system on the gradual addition of an electrolyte a point will be reached where adhesion will occur when two particles come together at a particular orientation with respect to each other, but not if they collide in any other way. Any stress which tends to destroy the orientation destroys the structure. With higher electrolyte concentrations, random coagulation will occur and irregular flocks will be formed.

Eloxal and the Seo Photo Process.

DR. ALEXANDER JENNY describes in *Forschungen und Fortschritte* (**12**, No. 5, 69) the new SEO (Siemens-Electro-Oxidation) process in Photography. The process consists essentially in covering a plate of Aluminium with a surface film of its oxide by oxidising the metal electrolytically in an acid medium. The thickness of the oxide layer is of the order of 2 to 20 μ.

(*Continued on page 889.*)

4 (12) -

SUPPLEMENT TO "CURRENT SCIENCE".

The Mechanism of Enzyme Action.

By Professor A. Fodor.

(*The Hebrew University, Jerusalem.*)

1. INTRODUCTION.

THE first to assert the momentous law of the reign of a catalytic power in nature, whereby complicated chemical processes, for whose realisation the chemist requires powerful reagents and high temperatures, become easily possible under the mild conditions prevailing in plant and animal organisms, was Berzelius in his famous *Text-Book of Chemistry*. At an early date the action of this catalytic power was traced to the Ferments, or Enzymes as they were termed later. The action was specific,—given effects being obtained only with given fractions of secretions or organ extracts and only under definite conditions of medium. Biochemists were thus led to postulate the existence of a multitude of catalytic "substances," whose chemical action was well known, but whose chemical nature remained a mystery. The specificity of the enzymes was set forth most sharply by the investigations of Emil Fischer on stereoisomeric substrates, investigations which led this researcher to draw his famous analogy of "key and lock".

As might be expected, these actions have been an unfailing source of stimulation for the researcher, and have ever spurred him on in his efforts to determine the chemical structure of the mysterious substances causing them. As yet, however, the aim has not been attained with enzymes. R. Willstätter, H. v. Euler and their collaborators tried for many years to prepare pure enzymes, but only succeeded in enhancing the activity of their preparations by freeing the total mass of cell and tissue ingredients from those parts which, in their opinion, contained little or no enzymic substance. But the residue obtained by them was itself nothing else again than a further mass of cell ingredients united with active substance, the chemical nature of which still remained as unexplicable as ever.

It is very difficult under these circumstances to speak of a purification of the enzymes. It is an open question whether the above mentioned concentration process really constitutes a true purification at all. By the expression purification the chemist understands the liberation of a compound (A) from other compounds (B, C . .) which generally stand in no direct relation to it. No such purification can be reported for enzymes. Willstätter, by the ingenious method he has developed, abstracts from the total number of carriers, as the mass charged with active substance may be termed, only those carriers whose activity is most manifest. The other carriers, however heavily they may be charged with active substance, are neglected by this method. The essence of the Willstätter method is the autolytic breakdown of the original native carriers, which being mainly colloidal do not, as we shall see, reveal their true degree of charge with active substance, into low derivatives which freely manifest their association with the active principle and hence also their function as carriers.

Before drawing such a conclusion, it was necessary for us to prove that different carriers variously enhance or depress the activity of the active substance (the very nature of which is still a mystery to us), even as a definite quantity of electricity charges variously bodies of different dielectrical properties which thus act as a real determinant of the "electrical activity".

Carriers which manifest the activity of their active substance we shall term zymophoric. The degree in which the activity

of the active substance in respect of a given substrate is made manifest by the zymophore corresponds to the degree of zymolability (or inversely to the degree of zymostability) of the zymophore. Zymolability is merely a qualitative and relative concept, however. In reality it is revealed to us only by the relative ease with which the active substance (zy. s.) is transmitted from the carrier (C) to the substrate, as well as by the effect of this transmission process.

$$C \longleftrightarrow \text{zy.s.} + \text{substrate} \rightarrow C + \text{substrate} \longleftrightarrow \text{zy.s.}$$

Assuming that the substrate on association with active substance undergoes chemical alteration (hydrolysis, decomposition, etc.) at an infinitely great velocity, it must be concluded that in kinetic experiments it is this transmission effect which is really measured. If the measurements are carried out in the first phase of the enzymatic action upon the substrate, before the formation of the cleavage end products has so far advanced that these products themselves become significant as carriers of active substance, the quantity of the substrate transformed during this period may be taken as a measure of the enzymatic activity, *i.e.*, of the transmission effect. In respect of any given enzyme extract prepared under exact and constant conditions and allowed to act either upon several substrates present in equivalent amounts in the same medium, or upon the same substrate under varying conditions of medium, the presence of different substances, for example, the amount of substrate transformed during the first phase (t) of the reaction forms a valid measure for comparisons of enzymatic activity. In no case, however, are the *actual* "enzyme units" or "enzyme quantities" determined by kinetical measurements. What is really measured is the transmission effect of assumed enzyme quantities, but not as is the case in ordinary kinetic experiments, an effect which is governed solely by the actual concentration or quantity of the reacting compound. To be sure, the very nature of this transmission effect is not yet definitely known. Enzymic activity is only the outward manifestation. The transmission itself probably involves a distribution of active substance between the carrier and the substrate, a distribution dependent for its realisation upon the occurrence of a definite manner of contact betwen the two bodies. The frequency of this contact, moreover, depends upon the nature of the carrier involved. This view thus assumes that a chemical and physical, constitutional and perhaps configurative, relationship underlies the mutual association of substrate and carrier. This assumption also provides the explanation of that other cardinal feature of enzymic action: its specificity.

Though the assumption that the velocity of a given reaction is determined by the frequency of the collisions of the reacting compounds and that this frequency in turn is proportional to their concentration is quite permissible in ordinary chemodynamical considerations, this assumption is not justified in the case of enzyme action. In this case the collisions must be of quite a definite nature, if they are to result in a manifestation of the above mentioned "chemical and physical relationship" between carrier and substrate. It is necessary for the colliding bodies to form a definite space pattern which is the prerequisite of their combination. The frequency of occurrence of appropriate collisions, *i.e.*, collisions in which the participating bodies assume the right position in space, is governed by a certain degree of probability and is increased if the chemical structure of the colliding bodies causes them to tend to "catch" each other. Only when these suitable collisions occur, is enzymic activity (with the transformation of activated substrate proceeding at infinite velocity) manifested.

We regard as zymophoric only such carriers which can enter into the above mentioned relationship with the substrate. Their zymolability is the greater, according as their chemical structure permits of a greater frequency of "appropriate" collisions, according as, that is, the "attraction" between the two partners is the stronger.

This is the interpretation which should be placed upon the fact that in peptidase action glycocoll behaves as a non-zymophoric carrier whose presence hinders the hydrolysis of the dipeptids. For higher polypeptid substrates, on the other hand, glycocoll appears to be an appropriate carrier, and its addition increases the rate

of the hydrolytic cleavage of such a substrate. Conversely certain proteins and their derivatives have been found to be fit carriers for the cleavage of dipeptids but less fit for higher peptids.

These observations may be brought to a head under a simple formula that proteins and their high derivatives enter more easily into the above described relationship with iow protein derivatives such as amino acids or dipeptids than with higher protein derivatives. The low protein derivatives moreover evidently possess no affinity for each other which could bring about the association of carrier and substrate. The higher products are thus seen to constitute the best carriers for dipeptids, the amino acids for higher polypeptid substrates. The fact that the higher derivatives seem to exercise almost no attraction for each other, is probably due more to the large, hence cumbersome size of their molecules, which lowers the frequency of "appropriate collisions", than to any lack of affinity.

Still a few words more on the chemical nature of the carriers. It is a striking fact that in peptidase action only substances whose chemical nature is much akin to that of the substrate, *i.e.*, substances of polypeptid structure, act as carriers. This is not a mere coincidence in our opinion but rather a significant peculiarity which is inherent in the nature of living matter. As an ingredient of the living plasma, a protein is charged from the very beginning with a definite quantity of active substance (zy. s.) which, on the decomposition of the protein to lower derivatives, is transmitted (in the sense defined) to the latter. It may be laid down as one of the main criterions of the substance of the living plasma that they are equipped with the catalytic agents of their own decomposition, the products of which beginning with the higher and lower intermediate derivatives and ending with the lowest final products, serve as carriers of the active substance which is successively transmitted to carriers of various zymolability and is thus enabled to fulfil the various biological functions. This is true not only of proteins but also of other cell ingredients of high molecular structure. The seed which contains protein, starch, lipins, etc., as reserve substances is at the same time thus provided with all the enzyme systems necessary for the decomposition of the substances under the condition of germination. Moisture and the proper temperature act upon these systems as activators. In this way the ingredients of the living substance provide above for the implements of their dissimilatory decomposition, acting themselves as the carriers of these implements and transmitting them also to decomposition products which in turn act as new carriers. In the light of these considerations, the chemical kinship which is generally displayed by the carriers of a given enzyme system, such as polypeptidase, and its substrate no longer appears astonishing. All are equally decomposition products of the same mother substance.

The existence of a multiplicity of carriers in the enzyme action, and the possibility of a change of carriers, whereby the appearance of new enzyme specificities may be explained, are the fundamental ideas of the conception advanced above. In view of the fact that the isolation of pure enzymes has not met with success despite manyfold attempts and that at every trial the researchers only succeeded in isolating new carriers, it seems plausible to suppose that enzyme systems are in essence but multitudes of carriers charged with as yet unknown active principles, and that specific action is the result of chemical adaptation in varying degrees of completeness between carrier and substrate. The adaptation is the greater, the greater the specificity, the latter being the measure of the possibility of combination, either between numerous kindred substrates and some highly specialised, configuratively adapted and irreplaceable carrier, as is the case with α-glucosidase. We have found no legitimate reason however for assuming as several researchers (Willstätter, v. Euler, etc.) have done that there are as many active substances as there are specific actions in a given group of kindred substrates, that in other words several "dipeptidases" and a multitude of polypeptidases exist. The experiments mentioned in Part 2 of this paper seem to show the relative truth of our view-point.

2. Some Proofs of the Multiple Character and Interchangeable Nature of the Carriers in Peptidase Systems.

In this section some experimental results are described which are only comprehensible

on the assumption that there exists a multiple of carriers for one and the same enzyme action, *e.g.*, the hydrolytic breakdown of polypeptids, that the appropriate individual carriers are mutually interchangeable, and that by the interchange the system's activity becomes altered.

The hydrolytic cleavage of polypeptids, both dipeptids and higher peptids (beginning with tripeptids and proceeding to higher forms) can be effected both by peptidase—wealthy yeast extracts and by pancreas extracts, or pancreatin preparates, *i.e.*, by the dried substance of the pancreatic gland. It hardly needs to be mentioned that these extracts also act on peptons which substances are known to be a mixture of higher polypeptids.

It was found (Abderhalden and Fodor, 1916) that fresh-water extracts of yeast on standing one or two days at room temperature, show a strikingly increased activity in respect of many dipeptids, but that this increased activity sharply drops again after five or six days more of preservation. The cause of this variation in activity which was invariably found to occur in extracts of dried Munchen yeast, could only be traced later to an autolytic breakdown by virtue of which the "active substance" of the polypeptidase system is transmitted from its native carrier—the yeast phospho-protein—to the products of this carrier's autolytic breakdown. Since the higher autolytic breakdown products (carriers K) which are appropriate, *i.e.*, zymolabile carriers for the splitting of dipeptids are formed first, the ability of the extracts to breakdown dipeptids at first increases. When in more advanced stage of autolysis however products of low molecular size (carriers X) and zymostable, as far as the hydrolysis of dipeptids is concerned, begin to predominate and the same activity falls. As has already been pointed out, however, we only arrived at this explanation later.

It was afterwards shown (Fodor, 1920-1922) that the original carrier of peptidase action in yeast extracts is phospho-protein a substance which these extracts contain in abundance. If the fresh maceration juices of yeast are precipitated with dilute hydrochloric acid, the protein coagulates in so delicate a form that, after filtration and cleansing with water, it may be redispersed by stirring with the latter forming a persistent suspension which exhibits all the characteristic features of a grossly dispersed colloidal system. The ultramicroscopical picture of the suspension shows extensive aggregate formation with but few single particles in a state of Brownian movement. Such an enzyme sol has been found to show under optimum conditions of concentration, temperature and pH a low but definite activity in respect of dipeptids. On carefully adding dilute sodium hydroxide to the sol, its activity increases, simultaneously, the ultramicroscopic picture obtained discloses a great increase in the degree of dispersion with single particles in strong Brownian motion, beginning to predominate over the aggregated forms. If however the addition of sodium hydroxide is carried too far, the field becomes empty, due to the formation of invisible alkali protein, and simultaneously the zymatic activity of the sol falls.

In this way was the existence of a definite carrier of enzymic substance proven, and the dependence of this enzyme's activity upon the physical state, *i.e.*, the degree of dispersion of the carrier demonstrated. In the case of a colloidal carrier, such as for example phospho-protein, an optimal degree of hydration is necessary for the manifestation of maximal degree of activity.

We were unable to decide at the outset whether the phospho-protein merely acts as a carrier of the peptidase action in the yeast and pancreas extracts (Fodor, 1922) or is itself the active substance or the enzyme. This question might have remained unanswered moreover had we not by a stroke of good luck found that glycocoll was a suitable elution agent for the kaolin adsorbate of yeast extract. All other elution means tried, aminoacids, other than glycocoll included, were fruitless. Stimulated by the adsorption and elution method developed by Willstätter, we (Fodor, Bernfeld and Schoenfeld, 1925) treated yeast macerates with a suitable form of kaolin which adsorbed their protein content. The adsorbate, after having been thoroughly washed, could be eluted with glycocoll. The eluate (A) proved to be active in respect of both dipeptids and peptons, particularly the latter. It was found to be nearly free of protein (with Esbach reagent, a very slight clouding resulted) but gave several of the colour

reactions, that with glyoxylic acid for example, and must therefore have contained some protein derivatives. Under aseptic conditions we were able to preserve this eluate without any change in its activity several months. An attempt to carry out a new kaolin adsorption and subsequent glycocoll elution did not succeed. The kaolin adsorbate of eluate A was itself active but admitted of no elution with glycocoll. At this juncture we felt justified in setting up the following scheme as representation of these adsorption and elution processes :

First adsorption : Protein ⟷ zy. s. + Kaolin →
→ Kaolin ⟷ Protein ⟷ zy. s. ;

First elution : Kaolin ⟷ Protein ⟷ zy. s. +
Glycocoll → Glycocoll ⟷ zy. s.

Second adsorbtion : Glycocoll ⟷ zy. s. + Kaolin →
→ Kaolin ⟷ zy. s.

Second elution : Kaolin ⟷ zy. s. + Glycocoll →
→ no elution

The elution process is only successful if the active material (zy.s.) is directly linked to the protein and not to the adsorbent.

At the later date (Fodor and Frankenthal, 1930, 1931), when we carried out the adsorption on kaolin of phospho-protein coagulated from yeast extracts by dilute acids, and eluted the adsorbate with glycocoll, we obtained an eluate B which was active in respect of the tripeptid leucyl-glycyl-glycine, but inactive in respect of the dipeptid leucyl-glycine.

Evidently, a carrier of category K (see above) which promotes the splitting of the dipeptid, must be assumed as present in eluate A. Since such a carrier is lacking in the much purer eluate B the latter is unable to hydrolyse the dipeptid.

Starting from this assumption we were led to the idea of attempting to bring about the activation of the eluate B in respect of the dipeptid by the addition of a carrier of the category K. With this aim in view we permitted yeast to undergo brief autolysis in the presence of acetic ether so as to obtain an increased yield of the high protein derivatives (K). When this operation was completed, an ultrafiltrate of the autolysate was prepared in order to separate the original unaltered protein from their newly formed K-derivatives. When the clear ultrafiltrate, which exhibited no enzymic activity whatsoever was added to eluate B, the latter was activated, splitting fully 32% of all the leucyl-glycine present in the course of 21 hours at the temperature of 25° C. In this way therefore eluate B aquired a capacity it had formerly lacked. The experiments thus furnished proof that for the cleavage of the dipeptid, glycocoll is an inappropriate carrier of the active substance of peptidase system. The dipeptid can only be split if carriers K, such as are contained in fresh yeast autolysates, are present.

It was shown by analogous experiments that pancreas extracts totally inactive in respect of glycyl-leucine but active in respect of glycyl-leucyl-leucine acquire an activity in respect of the dipeptid after an induction period of about 3–4 hours (37°) which is necessary for autolysis. It would be demonstrated, moreover, that the curve of the dipeptid hydrolysis followed the course of an autocatalytic process. This result admitted of no further doubt concerning the truth of the conclusion that the first products of the autolysis are the activators of the dipeptid hydrolysis. Moreover this conclusion furnished us with a convincing explanation of the results of our experiments of 1916 (s. above) which showed that the ability of yeast extracts to cleave dipeptids (and also peptons) increases with preservation.

This increase is evidently connected with an autolytic process wherein apparently not only carriers K but also products X of a further degree of breakdown are formed. For this reason apparently the ability to split peptons is also increased (even by 55%) on preservation under these conditions, *viz.*, for a period of three days at room temperature (Fodor and R. Cohn, 1928).

Some proof must still be furnished that the deep breakdown products (X) of the protein, among them amino acids, increase the activity in respect of higher peptids (and peptons) but not in respect of dipeptids. Experiments with this aim in view were carried out with maceration juices of pancreatic glands (Schoenfeld-Reiner, 1930).

The results showed that on the addition of pepton hydrolysates, rich in X carriers, to a mixture of this pepton and the macerate, the pepton cleavage was augmented, but that of the dipeptid decreased. Apparently the cleavage of dipeptids is obtained by carrier X.

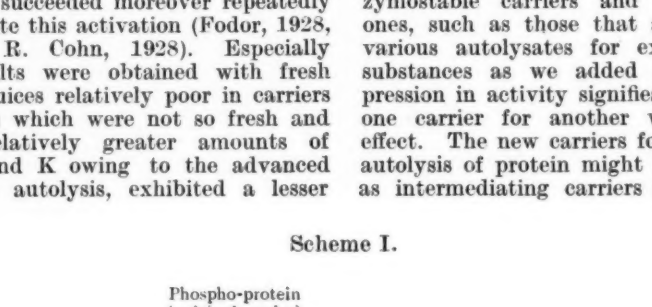
On the other hand, it could be demonstrated that pancreatin macerates which were deprived of the greater part of their carriers X content by a short dialysis, suffered a loss of activity in respect of peptones, but gained in activity in respect of dipeptids.

We are clearly led to expect from these results that the addition of amino acids which represent the extreme of the carrier X type, to a yeast extract would cause an activation of the latter in respect of peptones. We actually succeeded moreover repeatedly to demonstrate this activation (Fodor, 1928, Fodor and R. Cohn, 1928). Especially striking results were obtained with fresh maceration juices relatively poor in carriers X. Extracts which were not so fresh and contained relatively greater amounts of carriers X and K owing to the advanced state of the autolysis, exhibited a lesser degree of activation in respect of peptones on the addition of the amino acids.

On the basis of the experimental results described above, we felt justified in proposing the following carrier scheme (Scheme I).

The explanation advanced by the Willstätter school ascribes these activation and depression effects to the removal and appearance respectively of "detaining bodies" (Hemmungskorper), but this is merely a tautological circumscription of facts, and no true explanation. We only possess this latter when we have comprehended that the "detaining bodies" are nothing else than zymostable carriers. Their exchange for zymolabile ones brings an activation in its wake; exchange *vice versa*—a depression. The active substance is distributed, according to this view-point, between its original zymostable carriers and new zymolabile ones, such as those that are contained in various autolysates for example, or such substances as we added directly. A depression in activity signifies an exchange of one carrier for another with a contrary effect. The new carriers formed during the autolysis of protein might also be regarded as intermediating carriers (Scheme II).

Scheme I.



Scheme II.

(*a*) Carrier X ⟷ zy. s. + dipeptid —(by a slow transmission)→ dipeptid ⟷ zy. s.

(*b*) Carrier X ⟷ zy. s. + carrier K —(by a rapid transmission)→ carrier K ⟷ zy. s.

Carrier K ⟷ zy. s. + dipeptid —(by an accelerated transmission)→ dipeptid ⟷ zy. s.

It is evident that the relative quantities of zymostable and zymolabile carriers present will have a significant influence upon the effect of the transmission of the "active substance" to a given substrate and consequently also upon the zymotic activity in respect of the latter.

It may also be deduced from this statement that the constancy of an enzyme system is dependent upon the nature of the carriers of the active substance. As long as the carrier is a colloid, in which state as a rule, it is subject to incessant change, no constancy of activity can be expected. If active substance is transmitted to a protein derivative carrier which itself suffers cleavage as a result of this transmission, the breakdown will produce new carriers that will compete with the substrate, by acting themselves as substrates. In this competition however the substrate proper, owing to its greater concentration, gains the lion's share of active substance. Nevertheless it is a significant fact that such a system undergoes perpetual changes in activity, changes which are already revealed in the self-alteration of enzyme extracts and which researchers take into account by setting up parallel controls.

True constancy can only be expected where the carrier is not subject to changes of the nature mentioned above. This condition was fulfilled for example in our glycocoll eluates. The experimental verification of this fact provides additional proof that the eluting substance, *i.e.*, the glycocoll, is itself the actual carrier of active substance in the eluates.

3. THEORETICAL CONSIDERATIONS.

The following paragraphs deal with the nature of the zymoactive substance. This is still as has been pointed out above, a mystery to us. In discussing its chemistry therefore we enter a domain of pure hypothesis.

Our claim that zymoactive substance (zy. s.) distributes itself between the substrate and one or several carriers contains the implication that zy. s. possesses an affinity both for all the different but chemically kindred carriers and for the substrate which, as we have shown, also ranks among these chemical relatives.

This conception involves a further assumption. The chemical constitution of the zymoactive substance must admit a combination both with the multitude of carrier and with the substrate which itself acts in this case as a carrier. Consequently it was concluded that zymoactive substance possesses a common affinity for all these carriers, substrate included. But granting this, the existence of at least as many zymoactive substances as there are protoplasmic carriers of fundamentally different chemical constitution must also be granted. For it is inconceivable that the same active substance enters into combination both with the totality of proteins and protein derivatives and with such a substance as starch for example or other cell and tissue constituents.

We are thus led to conclude that the ground substances of the plasma are equipped above with zymoactive substances which are closely attuned to them chemically. When the ground substances are broken down into breakdown products of a kindred chemical constitution, the zymoactive substances become transmitted to them (see above).

These conclusions follow from our main premises. It follows further from the investigations of many researchers on enzymes that the active principle is impermeable to dialytic membranes and must therefore be in a colloidal state. Where the dialysis brings about the inactivation of the enzyme system, its activity can, as a rule, be restored by the re-addition of the dialysate to the dialysed solution even though both these fractions were themselves inactive. It may be concluded therefore that the active principle of the system does not diffuse through the membrane and that inactivation by dialysis is merely due to the removal of permeable activators.

On the other hand, we are compelled to conclude from the experimental results of several researchers that the separation or isolation of the active substance is an impossibility, and that its connection with a carrier is necessary for the manifestation of activity. When we attempt to attain the active material in pure form, all we ultimately get is inactive chemical substance. The zy. s., whose quantity is extremely minute, is lost during the purification procedure in the mass of purifying reagents.

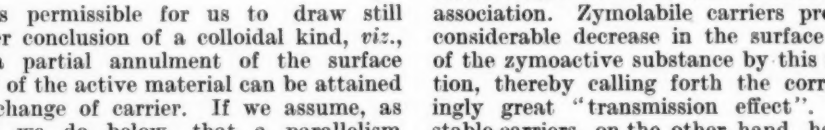
It seems right therefore to conclude that the colloidal active material depends for its existence on its connection with a carrier or substrate, *i.e.*, that the activity is only preserved in connection with the latter, and that separation brings inactivation in its wake, probably as a result of some change in colloidal state, such as coagulation. It is a commonplace experience of the colloidal chemist that substances which in a high degree of dispersion possesses enormous surfaces and fill correspondingly great volumes, are almost invisible to the naked eye and hardly measurable by weight after coagulation.

Consistent with our view that the active material is a colloid of high disperse degree which is linked to carriers and preserves its dispersion only as long as this linkage endures, we may go a step further and concede that the linkage to the carrier is to be ascribed to a compensation of the great surface energy, and that liberation from the carriers invariably involves the loss of this compensation and hence a coagulation. The carrier thus functions as a protective colloid: it preserves the colloidal state of the substance which is linked to it.

It is permissible for us to draw still another conclusion of a colloidal kind, *viz.*, that a partial annulment of the surface energy of the active material can be attained by a change of carrier. If we assume, as indeed we do below, that a parallelism exists between the surface energy and the activity, we may regard as zymophoric only such carriers as allow to maintain the high energy state; carriers which bring about its decrease may not be regarded as zymophores. On the other hand, the measure of zymolability is largely dependent upon the efficiency with which diminution of the surface energy maintained by a given carrier, is effected by the combination of this carrier with the substrate. According to energetical principles, the surface energy liberated by this combination must manifest itself as thermal, electrical or chemical activity (depending upon the conditions prevailing in the system under consideration), and hence we may also attribute the chemical change of the substrate to the partial liberation of surface energy which is brought by the combination of the carrier with the substrate.

We can now understand why that which above was termed "transmission effect" should not be represented as a kinetical problem only, for it is in the same time one in energetics. The quantity of the liberated energy depends both upon the nature of the combination which is effected between the carrier and the substrate and upon its intensity. It is easily comprehensible that a decisive rôle is played in this connection by the nature of the carrier which confronts a given substrate. Different carriers free different quantities of surface energy of zy. s. on combination with the same substrate. Not only relations which arise from chemical reactions between atoms come up for consideration in this connection, but mainly rather relations which are conditioned by the colloidal state of the zymoactive material, and arise from the space pattern and atomic constellation of the carriers and the substrate at their mutual association. Zymolabile carriers produce a considerable decrease in the surface energy of the zymoactive substance by this association, thereby calling forth the correspondingly great "transmission effect". Zymostable carriers, on the other hand, have but a small effect.

The protective action of the carriers upon the zymoactive substance is partially removed by the association of the carriers to the substrate. Consequently a corresponding dislocation which is conditioned by the intensity of the combination between the carrier and the substrate, and which liberates zy. s. occurs. The zy. s. thus liberated can fix itself upon the substrate and by this fixation some of the surface energy of the zy. s. is undoubtedly transformed into manifest chemical energy:



The transmission process can only take place of course, if the fixation of zy. s. by the carrier is sufficiently loose to allow the dislocation. If the zy. s. is closely fixed however, a zymophoric behaviour by the carrier is quite out of the question. Thus:

Carrier K ⟷ zy. s (high derivatives) ↕ easy linkage Dipeptids (low derivatives)	Easy dislocation of zy. s. and consequently an easy transmission.
Carrier X ⟷ zy. s. (low derivatives) ↕ difficult linkage Dipeptids (low derivatives)	Difficult dislocation and difficult transmission.
Carrier X ⟷ zy. s (low derivatives) ↕ easy linkage Higher polypeptids (peptones) (high derivatives)	Easy dislocation and easy transmission.

When high protein derivatives meet low derivatives, the dislocation and transmission are facilitated, since the association between carrier and substrate in this case is particularly easy.

On the basis of all that had been pointed out above, the answer to the question whether a given substance can act as a suitable carrier, is seen to depend upon the possibility of an association, in the sense already demonstrated in Part 1, between the carrier and the substrate in question, as well as upon the ability of the carrier to have entered into combination with the zymoactive substance without causing entire loss by this combination of the surface energy which the zymoactive substance possesses as a colloid and which it must liberate subsequently when the carrier and the substrate combine, if it is to effect chemical action such as hydrolysis or other cleavages.

The kinetic equation of an enzyme system must therefore take into account two factors: (1) the frequency of the "appropriate collisions" (see above) and (2) the quantity of surface energy ($\triangle\pi$), set free in a unit of zy. s. after the above mentioned collisions. With one and the same substrate both factors, the frequency as well as the $\triangle\pi$, vary according to the nature of the main and the subsidiary carriers.

Yet it may occur that a carrier T which is itself now zymophoric in respect of a given substrate is made zymophoric by the presence of a second, for its part zymophoric, carrier T_1 (Fodor and Frankenthal, 1930):

$$T \longleftrightarrow \text{zy. s.} + \text{substrate} \longrightarrow \text{no transmission}$$

$$T \longleftrightarrow \text{zy. s.} + T_1 \rightarrow T_1 \longleftrightarrow \text{zy. s.}$$

$$T_1 \longleftrightarrow \text{zy. s.} + \text{substrate} \longrightarrow \text{substrate} \longleftrightarrow \text{zy. s.}$$

The part played by T_1 is thus that of a mediator or even "activator".

The conception of the existence of mediators of this kind was advanced by the author (Fodor, Kuk and Frankenthal) as early as 1928. The fact of their existence has recently been confirmed by O. Warburg (1935), who ascribes a similar part to the "yellow flavin enzyme," as mediator of the hydrogen transmission in the alcoholic fermentation system of yeast.

The ideal form of the kinetic equation of, for instance, the hydrolysis of a dipeptid to amino acid molecules

$$\begin{array}{l} \quad\quad R \quad\quad\quad R_1 \\ NH_2\text{-}CH\text{-}CO\text{-}NH\text{-}CH\text{-}COOH + H_2O \\ \quad\quad R \quad\quad\quad R_1 \\ = NH_2\text{-}CH\text{-}COOH + NH_2\text{-}CH\text{-}COOH \end{array}$$

must be postulated under the following premises:

Let us conceive a single highly zymolabile carrier T. Let us further assume that none of the hydrolytic products act as carriers. Let the unit of zymoactive substance, whose quantity Z may be assumed to remain constant during the initial time interval t, call forth an energy change $\triangle\pi$ equivalent to the surface energy loss $\triangle\omega$.

Then the quantity of energy transmitted to the substrate will be $E = \triangle\pi . Z$ (= effect) and

$$\frac{dx}{dt} = E.k\,(a-x)^n = \triangle\pi.Z.k\,(a-x)^n.$$

In this equation a represents as usual the concentration of the substrate at the beginning of the action, $(a-x)$ its concentration

after a time t (x being the quantity transformed), k and n are constants of which the latter depends upon the frequency of the "appropriate collisions" and generally has a value of about $\frac{1}{2}$ but varies with the pH of the whole enzyme system. Under certain experimental conditions n may even be equal to 1. In this case E really being constant the equation would assume the external form of a reaction of the first order. We may easily see also from this equation how one and the same quantity Z can produce radically different degrees of zymotic activity (as measured by the quantity $\frac{dx}{dt}$) according to the quantity of the effect E, a quantity which is determined by the nature of the carrier.

To be sure, this kinetic equation is in practice rarely realised in its ideal form. Numerous disturbing factors intervene. Such for instance are the products of enzyme action which may either accelerate or slow the hydrolytic process, thus changing the value of both E and the constants.

From the point of view of kinetics, the enzyme action is thus seen to be a highly complex, and a but little elucidated process. It was only great optimism which moved former researchers to hope that they could make the kinetics of enzyme action conform with those of so simple a process as the cane sugar inversion found by Wilhelmy.

Natural phenomena are found to be more complex and intricate the deeper we penetrate into their profundities. To this fact the mechanism of enzyme action is an abundant testimony.

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A peculiar property of such an "Eloxal" (Electrolytically Oxidised Aluminium) is its porosity, the film being covered with a network of pores the diameters of which are of colloidal dimensions. It is this porosity of the Aluminium film in Eloxal that is responsible for its many valuable applications.

This porosity enables Eloxal to absorb liquids. The Eloxal plate can be charged with light-sensitive chemical either by tanking it in an aqueous solution of the reagent or (with water-insoluble chemicals as silver halides) by causing the reagent to be precipitated within the porous film. The Eloxal plate is now ready for the SEO photograph employing the usual photographic processes. Only, the pores in the oxide film have to be closed finally by rubbing the plate with either a suitable fat or wax. The cost of the Seo Eloxal photo is stated to be no higher than the ordinary photograph.

The Seo photo possesses many useful properties. It is not affected by temperature, by the common organic solvents, by seawater, and by the ordinary corroding factors. The Seo photo can be heated up even to the m.p. of Aluminium (658°) when the photograph is still clearly distinguishable on the oxide film. These properties give the Seo photo a large field of utility. It is excellently adapted to the manufacture of Placards, Scales and other Measuring Instruments, Notice Boards, Passports and other Legal Documents, Maps and Plans, etc.

The porous Eloxal film allows the deposition of various colouring matters enabling the manufacture of "Coloured Aluminium". When Eloxal, deposited with colloidal gold, is heated to various temperatures, the surface of the material takes on various shades of rich brown-red tints. Beautiful imitations of the grain and colour of timber and marble can be imparted to Eloxal which can be used as fire-proof panelling in the interior decoration of ships, æroplanes, railway carriages, etc. It can also be used in the wide field of applied art and in the manufacture of fancy-goods.

The great variety and extent of use indicated above, to which Eloxal can be put, it is claimed, is of national importance to Germany which does not possess copper deposits and is endeavouring to minimise the use of the metal and its alloys. The development of Eloxal is, therefore, another step in the German effort towards national self-sufficiency.

Eloxal was invented and developed by Jenny and Budilhoff, two Engineers on the staff of Siemens & Halske, A. G., Berlin, who have protected the invention by a series of patents.

EMMENNAR.

Silica Fluff.

A NEW form of hydrated silica, having unusual properties, prepared by slow drying at low temperature of the transparent gel resulting from the action of silicon tetrafluoride on water has been described by Jacobson (*J. Phys. Chem.*, 1936, **40**, 413) and is called Silica Fluff on account of its fluffy nature. This extremely light, opaque, white powder has low specific gravity, contains inclusions of air bubbles (1 to 1·5 microns) which give colour phenomena with polarised light and which cannot be dislocated by a vacuum pump. Its percentage composition leads to the empirical formula $(SiO_2)_{12}3H_2O$ and the graphic formula has also been speculated.

K. S. RAO.

The Movement of Protoplasma in Plant Cells.

THE movement of protoplasma within the plant cell as a result of irritation is a well-known phenomenon, the wounding of Vallisneria and allied plants furnishing striking examples. Prof. Hans Fittig of the University of Bonn has investigated (*Forschungen und Fortschritte*, 1936, **12**, 160), whether in such cases, the cause of the movement is due to purely mechanical influences or whether it is traceable to any chemical stimulant formed as a result of the injury. Fittig, by careful experimentation, shows that the extract from crushed Vallisneria leaves contains a substance which is stable towards heat but susceptible to bacterial decomposition and which in dilutions as low as 1 in 2 millions causes the movement of protoplasma in plant cells. As a first step in the elucidation of the nature of this active principle, Fittig sought to find if any known substances are capable, in dilutions of a comparable order, of causing such protoplasma movement. He finds that Amino acids are capable of such irritation. α-Amino acids are the most active, the potency rapidly diminishing with the β, γ, etc., isomers. Further, the Amino acids in their naturally occurring

optical isomeric forms are very much more active than their artificially prepared optical antipodes.

The effects of different Amino acids on a given plant cell vary enormously. By far the most active are Histidine (effective in concentrations as low as 1 in 600 millions) and Methyl Histidine (1 in 3,000 millions). Fittig considers it probable that the Vallisneria extract used in his experiments contains either about 1% Histidine or about 0·2% Methyl Histidine. The extract did not respond to the diazo colour reaction with Diazobenzenesulphonic acid which is sensitive to Histidine in concentrations of about 1 in 100,000. Fittig does not, however, consider this as conclusive or even significant because the reaction is easily masked by the presence of Methyl Histidine and other foreign substances which presumably are present in the Vallisneria extract. Work is in progress to find other methods of detecting Histidine. The importance of Fittig's work lies in the fact that α-Amino acids which till now were considered to be physiologically indifferent in plant life are shown to be in reality very active substances comparable to the physiological potency in animals of Thyroxin, another (though highly complex and Iodine-containing) Amino acid.

EMMENNAR.

A New Mode of Fixation of Nitrogen in Soils.

DHAR AND CO-WORKERS, in their extensive investigations, have shown the importance of light in many oxidation processes taking place in soils. In a recent paper (*J. Indian Chem. Soc.*, 1936, **13**, 155–179) N. R. Dhar and S. K. Mukherji have pointed out a new possible way in which light is helpful in the fixation of nitrogen in soils. When some sterilised soil suspended in a medium containing dissolved carbohydrates (like glucose, cane sugar, molasses, etc.) is exposed to sunlight for a long time, it is found that there is an appreciable increase in the available and the total nitrogen contents of the soil. The energy set free during the photo-oxidation of the carbohydrates seems to fix the atmospheric nitrogen. The efficiency of nitrogen fixation obtained in the induced oxidation of sugars is of the same order as that with cultures of Azotobacter thriving in flasks containing solutions of energy-rich compounds. These observations have been correlated with the results obtained in some field experiments undertaken for studying the effect of molasses on soils.

K. S. G. D.

Thermal Decomposition of Talc.

EWELL, BUNTING AND GELLER (*J. Research National Bureau of Standards*, 1935, **15**, 551–556) describe the changes which accompany the careful heating of a specimen of nearly pure talc from Manchuria. The furnace employed for the purpose could be heated up to 1435° C., and the temperature rise adjusted to about 6° per minute.

Observations with a differential thermocouple revealed two endothermic effects (both irreversible) at about 530–572° and 860–953° respectively. Determinations were simultaneously made of the weight losses suffered by the sample at different temperatures ranging up to 1435°, the period of heating at each temperature being 2-22 hours.

X-Ray and microscopical examinations were made of the unheated material as well as of the material heated to different temperatures. The X-Ray camera was divided so that comparison patterns of the test and reference specimens could be obtained on the same film.

It was found that between 380–500° all the water present in excess of 1 molecule was driven off from talc but without any alteration in crystal structure. The molecule of combined water was removed at 800-840° and this was accompanied by breakdown of the talc into enstatite and amorphous silica and also by an increase in specific gravity. On further heating up to 1300°, the enstatite changed into clinœnstatite and amorphous silica into cristobalite. The final products of the thermal decomposition of talc were found to be clinœnstatite and cristobalite, and the specific gravity of the fully decomposed material was found to be 3·01 as compared with the value 2·83 for the unheated specimen.

K. R. K.

Histophysiological Study of Testis.

PROF. JACQUES BENOIT has a very interesting paper in the Actualités Scientifiques et Industrilles (*Exposés de Biologie*, 1935, **3**, 3–64) on "Le Testicule" as an organ elaborating the male sexual hormone. He has studied the testis from the morphological and histophysiological view-points. This

study has enabled the author to divide the testicular cells under three heads, *viz.*, the *lignée seminale* forming the reproductive cells, the cells of Leydig and the cells of Sertoli. The latter two sets of cells are probably derived from the same cellular layer in the Gallinacea and the same is also likely to be the case in mammals and the other groups of vertebrates. The transformation of the Sertoli cells into glandular interstitial cells is accompanied by the loss of Sertoli characters and the acquisition of a secretory activity. The cells of Sertoli play *vis-a-vis* to the seminal elements the rôle "d'un terrain somatique trophique". The interstitial cells secrete endocrines, which hormone is responsible in the development and functioning of the secondary sexual characters and the accomplishment of reproduction.

The Arteries of the Chimpanzee.

As a result of the examination of ten specimens of the Chimpanzee (Pan spec ?), E. M. Glidden and C. F. De Garis (*Amer. Jour. Anat.*, March 1936, **58**, No. 2, 501) have distinguished five types of aortic arches. In one, which exemplifies the normal human sequence, three trunks, the *a. anonyma*, the *a. caroticus communis sinistra* and the *a. subclavia sinistra* arise from aortic arch. In the second type, *a. truncus communis* gives rise to *a. anonyma* and *a. carotis communis sinistra*. This condition is found in a single specimen out of the ten examined. The third pattern occuring in four specimens, simulates the first except that a small *a. thyroidea ima* arises directly from the arch between *a. anonyma* and *a. carotis communis*. The fourth type is characterised by the *a. thyroidea ima* arising from the *a. carotis communis* instead of directly from the arch. This occurs in two specimens. The last condition is characterised by the fusion of the bases of *a. carotis communis* and *a. subclavius sinistra* to form *a. anonyma sinistra*. The *a. thyroidea ima* always arises from this *anonyma sinistra*. This occurs in two specimens.

In the single specimen which the authors have dissected for the arteries of the descending aorta and of the pelvis and the extremities, it is seen that *a. subclavia* lacks the *a. thyroidea* inferior and the relation between the *a. axillaris* and *plexus brachialis* is seen to be different from that obtaining in man. The visceral branches of the descending aorta are in the main similar to the human pattern. In the pelvic region the obturatoria is rudimentary and the *circumflexa femoris medialis* arises from the external iliac.

The Idea of Contrasted Differentiation.

PETROLOGISTS are aware that during the last few years S. R. Nœkolds has been developing his hypothesis of contrasted differentiation to account for the variation in igneous rocks. His main contention is that in intercrustal magma reservoirs, differentiation yields two contrasted magma types—acid and basic, which manifest as intrusions, with the basic member invariably coming out first, and that most of the intermediate rock types are commonly the products of contamination. Recently Aurther Holmes (*Geological Magazine*, May 1936, No. 863) has shown that the idea of contrasted differentiation as advocated by S. R. Nœkolds is beset with many inconsistencies and objections so fundamental as to be in direct variance with the physico-chemical principles of crystallisation differentiation established by Bowen. In discussing Nœkolds's evidences in support of contrasted differentiation, Holmes observes that the occurrence of contrasted rock types in close proximity does not constitute any direct proof for contrasted differentiation especially in view of Fenner's observation where he has shown that the alternate outpourings of typical basalt and typical rhyolite with little or no lava of intermediate composition. Hence according to Holmes preference must be given to the hypothesis of progressive crystallisation differentiation for which there is at least a convincing experimental basis rather than contrasted differentiation for which there is no real evidence at present.

Recent Investigations into the Principles of Irrigation and Cultivation of Orchards.

By Sohrab R. Gandhi, M.Ag.,

Superintendent, Ganeshkhind Fruit Experiment Station, Kirkee.

THAT irrigation is indispensable in many parts of India for the best production of horticultural crops is a fact widely recognised. In many of these areas, canal water is not available and recourse must be had to lifting or pumping from underground supplies. In the canal as well as in the pumping areas, water for irrigation is relatively limited. Economical and scientific use of the available supply is therefore of vital importance.

Because of wide variations in soils and of the extreme differences in topography, the cultural and irrigation methods must vary widely in different parts of India. During his recent visit to the United States of America the writer had an opportunity to discuss the various aspects of the problem connected with the cultivation and irrigation of orchards, a subject which has been receiving considerable attention at the hands of research workers in the University of California. These investigations have definitely modified certain old and widely current beliefs and have advanced new conceptions which afford a better understanding of the subject.

The practices of irrigation and cultivation are so interrelated that it is almost impossible to discuss the principles underlying each of these separately. It must be made clear at the outset that it is not the intention of the writer to discuss in this paper all the physical forces involved in the occurrence of moisture in the soil and its behaviour, but it is proposed only to speak of soil moisture from the view-point of its availability to plants.

The water which a soil absorbs and stores for use by plant roots is held in the form of moisture films which adhere to the soil particles. When water is applied to soils it distributes itself about the soil particles wetting each to its maximum film thickness as it passes downward under the influence of gravity. The amount of water held in the soil after the excess gravitational water has drained away and after the rate of downward movement of water has materially decreased, is termed "Field capacity" of the soil.

The downward movement of water in the soil is due almost entirely to gravity and not to capillary movement. Recent investigations show that capillarity cannot be depended upon to distribute moisture uniformly in the soil. The belief that "the moisture content of all of the soil occupied by the roots of the trees will be raised to a certain percentage by the applications of small amounts of water, because of the downward capillary movement of the water with a consequent equalisation of the moisture content of all of the soil" is incorrect.

When water is applied to a dry soil it is moistened to its field capacity to a definite depth. According to Veihmeyer[1] "All attempts to maintain a soil moisture percentage less than that which the soil would hold against the force of gravity, the maximum field or capillary capacity have met with failure." He further observes, however, "that the soil moisture supply could be kept above a certain minimum. The soil could be raised to a maximum content and this condition re-established when the plants had reduced the soil moisture supply to a certain minimum."

In view of the above investigations the amounts of water applied to a soil will affect only its moisture content to a certain depth and that much quantity of wetted soil will be raised to its maximum field capacity. Smaller amounts of water will wet a soil to its field capacity to a smaller depth while larger amounts will wet it to a larger depth. Hence, a light irrigation wets a shallower depth of soil to its field capacity than a heavy one does.

Soon after a soil has attained its "field capacity" the moisture content begins to decrease due to evaporation from the surface and extraction of water by roots of weeds or trees, that is, the moisture content fluctuates between "field capacity" and some percentage of moisture at which plants wilt and will not revive unless water is again applied. Soil physicists have named this stage of soil moisture as *permanent wilting percentage*, and the moisture in the soil above this condition is called the *readily available moisture*. Before we proceed to discuss as to how this readily available moisture is utilised by plants it is important to know how the water moves in the soil from one point to another. As already explained above, when water is applied, it penetrates the soil in a downward movement and laterally under the influence of gravity. Once the soil attains its "field capacity", the moisture, according to the recent investigations in the United States, remains almost stationary and is not able to move appreciably in an upward or lateral direction from the moist layers of the soil to the drier ones. In view of these investigations, therefore, the familiar conception that moisture is capable of moving in the soil in all directions through capillary forces needs modification.

Earlier investigators like King,[2] Hilgard,[3] and Longhridge and Widtsoe[4] have laid great stress upon the losses of moisture through evaporation from the soil surface by upward capillary movement. This theory of upward capillary movement in the soil apparently was advanced as a result of the study of the movement of moisture in soils contained in glass or metal cylinders where the lower ends remained in contact with free water. On the other hand, the study of the movement of moisture from a moist to a drier soil in the absence of water table within 6 to 10 feet depth received much less attention in early days.

[1] Veihmeyer, F. J., "Some factors affecting the irrigation requirements of deciduous orchards", *Hilgardia*, 1927, **2**, No. 6.

[2] King, F. H., *Soil Management*, Orange Gudd Co., New York, 1-303.

[3] Hilgard, S. W., *Soil*, The Macmillan Co., New York, 1921.

[4] Widtsoe, J. A., *Principles of Irrigation Practice*, New Ed., The Macmillan Co., New York, 1914, 1-496.

However, as early as 1913 Rotmistrov[5] from Russia drew attention "that water percolating beyond a depth of 40 to 50 centimetres does not return to the surface except by way of roots." Harris and Turpin[6] and Alway and McDole[7] were some of the early investigators in the U.S.A. to study the movement of moisture from moist soils to soils containing lesser amounts of moisture. Their investigations indicated, though not very conclusively, that the movement of moisture, especially in an upward direction from moist soils to drier soils is not at all appreciable when the source of the moisture supply is not saturated soil in contact with a free water surface. The most outstanding of the present-day investigations in this respect are those of F. J. Veihmeyer[1] of the University of California. His extensive experiments in pots as well as in the field have demonstrated that the capillary movement of moisture from the moist to drier soil when the soil is not in contact with a free water surface is too limited in extent and rate to be effective for use by plants. After the water applied to the soil becomes uniformly distributed by gravity, or in other words when the soil attains "field capacity", the upward as well as lateral movement of moisture from the surface layers of soil is due to direct evaporation and the loss from the lower layers occurs chiefly by way of roots of trees or weeds growing on it. Mulching is useful in so far as it removes weeds, etc., which deprive the soil of its moisture. Commenting on the phenomenon of upward capillary movement of soil moisture Keen[8] observes, "Upward capillary movement of water is now known to be effective over short distances only. Hence, the conception of a mulch as breaking the capillary channels and thus preventing water from actually reaching the soil surface is invalid, unless a permanent or temporary water table exists within some 6 feet from the surface." It may be assumed, therefore, that in the presence of a permanent or temporary water table within 6 to 10 feet distance, the water in the soil moves by capillarity, the distance and rate being determined largely by the fineness of the soil particles.

Under these conditions capillary movement is most rapid in the coarser soils (sands), but only for a short distance. In the finer soils (clays) movement is slower but occurs to a greater distance. Such a capillary movement of moisture also occurs from the bottom of the irrigation furrows so long as water is running in them. It also takes place in shallow soils underlaid by hard pan after irrigation due to the hard pan serving as a temporary water table. However, in well-drained orchard soils of good depth and structure but with a low water table the capillary movement of water is of no practical consequence in irrigation practice.

If we were to find that the moisture in the soil after it has attained the stage of "field capacity", does not appreciably move in any direction in absence of a water table, as has been also the field observations of the writer in the Bombay Deccan soil, we should then unhesitatingly lay down the following principle for irrigation practices :—

> "That whatever the system of irrigation adopted, it must ensure that all of the soil in the root zone is wetted. If the irrigation water wets a part of the root zone, only the roots in the wetted area will have water and the roots in the non-wetted area will suffer from lack of it."

Having learnt how water occurs in the soil we now direct our attention to study under what conditions plants can make the best use of it. The important factors affecting the rate of use of water by plants are the extent and vigour of the transpiring leaf surface, atmospheric temperature, humidity of the air and air movement. The larger the leaf surface the greater will be the loss of water from leaves. The atmospheric combination under which the greatest use of water occurs is that of high temperature, low humidity and high wind velocity, conditions so very common in the arid zones of California and which are very similar to the severe weather conditions obtaining in most parts of Northern and Central India.

The consumption of a certain quantity of water by the plant is determined by its leaf surface and weather conditions irrespective of the kind of soil on which it grows, the soil merely serving as a reservoir from which water is extracted by the plant in accordance with its needs. Since light soil has a low water-holding capacity its supply is more quickly exhausted than a heavier soil with a higher water storage capacity. Consequently irrigations on light soils are lighter and more frequent. The amounts of water used by plants of similar leaf area and under the same climatic conditions are precisely the same whether growing on light or heavy soil.

The amount of water to be applied at each irrigation varies with the kind and depth of soil to be wetted and the moisture content at the time of irrigation. There is no advantage in applying water to soils already wet as it merely passes on downwards and is lost. The soil is said to be over-irrigated when enough water is applied to deep soils to cause percolation below the roots or waterlogging of shallow soils and when the applications are so frequent as to affect aeration of the soil.

The combination of fruit trees and cover crops needs more water during the growing season than trees alone ; therefore, in the rainless districts they should never be attempted unless there is an abundant water supply available from canals or rivers. The Philippine Department of Agriculture are conducting a series of experiments on the value of permanent cover crops in alternating rows with Citrus trees under very heavy rainfall conditions. The permanent thick bushes of *Crotolaria* sp. and such other legumes are expected in this scheme of cover cropping to

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[5] Rotmistrov, V. G., "The nature of drought according to the evidence of the Odessa Expt. Station, 1913, Russian ed.," 1911–1913, 1–66 (English translation), Sta. M. of L. and A., Dept. of Agri., Odessa.

[6] Harris, F. S., and Turpin, H. W., "Movement and Distribution of Moisture in Soil," *Jour. Agr. Res.*, 1917, **10**, 113-153.

[7] Alway, F. V., and McDole, G. R., "Relation of movement of water in a soil to its hygroscopicity and initial moistness," *Jour. Agr. Res.*, 1917, **10**, 391-428.

[8] Keen, B. A. "The Physical properties of the soil," *The Rothamsted Monographs on Agr. Science.*, Longmans, Green & Co., London, 1931.

absorb the extra amount of water during periods of torrential rains and prevent erosion of the soil, as well to prevent leaching of manures.

As has already been stated, the loss of moisture stored in the soil is caused by extraction by the roots of the trees and other plants or weeds growing in the orchard and by evaporation directly from the surface of the soil. Viehmeyer's[1] experiments show that "The amount of water used in transpiration comprises a predominent part of the total losses from the soil under California conditions". While considering the problems of storage and loss of soil moisture we should not overlook the part the tillage plays in manipulating the soil for successful orcharding. According to Veihmeyer's[1] investigations cultivation alone does not help to conserve moisture in absence of a water table and if a water table does exist within 6 to 10 feet from ground level and water is lost by capillarity, there is a greater need for drainage in such soils rather than a mulch to conserve moisture. In the case of dry farming of grain crops, cultivation may help to some extent to prevent loss of moisture through soil cracks if they are of sufficiently large size; but the loss of water by evaporation from the small surface cracks under uniform soil conditions in an orchard takes place at such a low rate that probably nothing would be gained by covering them before the next irrigation is due.

The main purpose of cultivation in the light of recent investigations in California is to avoid weed competition or any other influence the weeds may have rather than the other effects such as soil aeration. Surface cultivation does not increase aeration in the soil depths occupied by the roots of the majority of our fruit trees and sufficient aeration ordinarily takes place in orchard soils regardless of whether or not the soil is stirred at the surface; and rapid nitrification may take place below the depths affected by tillage. On the other hand, unfavourable conditions for aeration may be produced if water is applied frequently enough to fill the pore space in the soil and maintain this saturated condition for long.

The usual practice of hand digging orchard soils at intervals after irrigation in the Bombay Deccan is certainly beneficial in a restricted sense in so far as it makes the soil more absorbent of irrigation water, but it should not be overdone with a view to aerating the roots or to conserving moisture.

In addition to the removal of weeds, cultivation is indispensable for planning irrigation methods, for preparing seed beds and incorporating cover crops and manures, for facilitating the control of certain pests and aiding in the absorption of water where it is a case of an impervious condition of the soil.

Deep tillage is often harmful in orchard soil inasmuch as it tears the roots of many shallow rooted trees. All tillage operations, therefore, in the orchard should be as shallow and only as few as necesary to accomplish the useful purpose given above.

The root activity of the tree is very much affected by soil temperature, soil oxygen supply and the presence of available nutrients in the soil. The wet soils are supposed to be cold. The soils naturally warm up as their moisture content decreases. Root growth and absorption are definitely retarded by keeping the soil too wet and are accelerated by permitting it to decrease in moisture content. A natural means by which soils are ventilated and aerated has to do with fluctuations in moisture content. Air is driven out when the soil is wetted and returns when it dries out. With the return of the air the soil warms up and the bacterial activity increases resulting in increased fertility available to plant roots. Different plants are said to have different ranges of soil temperatures at which their roots make active growth or remain dormant. The tropical and sub-tropical fruits are known to have relatively high temperature requirements for root growth.

According to Prof. Hodgson[9] of the University of California the Citrus tree shows no root activity below 55° F. and the roots grow most actively at approximately 80° F. Above 80° F. the rate of growth falls rapidly and at 90° F. it practically ceases. The root growth in relation to soil temperatures under tropical conditions may behave differently. It is imperative, therefore, that the study of soil temperatures in relation to root growth should occupy our immediate attention in orchard practices.

The problem of the setting of blooms in Citrus and other semi-tropical fruits in the Bombay Deccan is almost as much dependent on soil temperature as on a change of weather and the writer believes that the present exhaustive method of root exposure to force flowering of the above fruits could easily by replaced by a more rational system of judicious watering so as to allow moisture to fluctuate widely between the field capacity and the permanent wilting percentage. On the other hand, the problem of flower and fruit drop especially in arid regions and under hot severe weather conditions is often tied up with the lack of proper humidity in the orchard at the time of setting and the excessive transpiration taking place under these conditions. Much harm can be averted at this time by flooding the orchard at close intervals and maintaining a strong windbreak around the orchard. Again, the Dieback disease of Citrus trees in the Deccan in the retentive black soils with impervious sub-soils is as acute a problem as one connected very probably with the defective oxygen supply and the resulting low temperatures in the soil. The nitrifying bacteria also require a fairly high soil temperature (85° to 95° F.) and high oxygen requirements for their activity, conditions only possible if the soil moisture fluctuates far below the field capacity and above the permanent wilting percentage.

In view of the above remarks, it is necessary to allow soil moisture to fluctuate in wide limits in order to allow the soil to attain the required high temperatures.

Veihmeyer's experiments on deciduous fruits[1] (Prunes, Peaches and Apricots) and with various kinds of soils (clay, sands, loams) in North California show that plants are not at all adversely affected unless the soil is depleted of its moisture to the permanent wilting percentage. According to his investigations it makes no difference to the abovementioned trees so far as its normal growth and fruiting is concerned, however low the soil moisture may fluctuate between field capacity and the permanent wilting percentage. According

[9] Hodgson, R. W., "Some fundamentals of irrigation," *Year Book of the Calif. Avo. Assoc.*, 1927.

to his findings there is no particular optimum water content for growth in the soil between field capacity and permanent wilting percentage at which plants grow best. This is a revelation to orcardists in India who are given to thinking that by keeping the soil moisture content at a high level by flooding the orchard, at close intervals during the maturing period, they are able to swell the fruits to larger size. Veihmeyer and Hendrickson[10] while experimenting in the North and Central California Fruit Valley found that the size of the peaches and grape berries did not seem to be affected by irrigation near the time of picking.

The principle of depleting soil of its moisture to a condition approaching the permanent wilting percentage is not only in common practice in the cultivation of deciduous fruits in North and Central California but it is now also engaging the attention of the growers of evergreen fruits like the Avocado and Citrus in Southern California. The writer believes, however, that with the scanty knowledge of the requirements of tropical fruit trees and of soil moisture conditions in India, it would be risky to allow the soil moisture to fluctuate very close to the permanent wilting percentage in the principal root zone of the trees, but it seems that some minimum safely above the danger point of wilting should be the limit.

Naturally the question arises as to how without the aid of scientific apparatus one should be able to judge whether the soil has enough readily available water or if it is very near the danger point of wilting. In fact the orchardist himself should be in a better position to judge when his trees need water than any one else because of his close associations with his trees as well as the soil. The best method by which the grower can decide when to apply water is by cautiously prolonging the irrigation intervals in a small portion of his orchard and watching the condition of his trees and feeling the moisture in the soil of the *principal* root zone by hand. After a few trials of this kind he will soon become familiar with the degree of soil moisture which would be safe for his trees and the condition of soil dryness which would cause wilting. Experienced practical irrigators usually foretell the approach of soil moisture to wilting percentage from a flabbiness and a slight change of colour in the leaves and stalk of the plants. The lack of readily available moisture is easy to detect in the case of succulent trees like the Papaya and the Banana but it is not always easy to detect this condition from many stiff leaved plants. In such cases Veihmeyer[1] suggests that some kind of broad-leaved weeds, if allowed to grow in the orchard, would serve as indicators of soil moisture. Generally these weeds in California are deep rooted enough to indicate by their drooping of leaves a depletion of the readily available moisture in the part of the soil occupied by roots of the trees. Where only small streams of water are available, as in most fruit areas in India, the anticipation of the time when the permanent wilting percentage will be reached is very important in order that irrigation may be started in good time to cover the whole orchard.

It is impossible to assign any specific water requirements for particular orchard trees. They vary with the age, vigour and size of the trees and in accordance to weather conditions, being lowest in the humid regions and highest in the drier regions. Irrigation practice must, therefore, be determined primarily on the basis of the water requirements of the trees, the water-holding capacity of the soil and the amount of moisture in the soil as determined by periodic examinations by means of a soil augur or some such instrument. In California it is a common sight to see Citrus growers testing soil moisture by means of big iron augurs.

The method of irrigation must be governed by the topography and supply and must be so arranged as to guarantee uniform distribution and penetration of water. Whatever may be the system of irrigation flood, basin, ring or furrow, water must penetrate to the lowermost root zone of the tree to obtain best results. The length of spacing of the furrows and duration of running water into the furrow will have to be adjusted according to the rate of downward and lateral percolation of water while irrigating that particular kind of soil. The soil between furrows drawn too far apart is likely to remain unwetted. Where irrigation furrows are drawn in the space between two tree rows and beyond the drip of the tree-crown as is the practice in Citrus orchards of Southern California, the roots underneath the crown of the tree will benefit from the irrigation water to the extent the irrigation water runs and percolates laterally in a definite length of time through the first furrow on the side of the tree row. In this method of soil management, manure and water having been applied from the time of planting mainly beyond the drip of the trees, the feeding zone of the roots is largely built up in the irrigated area near and beyond the drip quite unlike the feeding root zone of fruit trees very near the tree trunk in the Bombay Deccan and in many parts of India where the irrigation and manuring system consists in providing a round basin or a pit close to the trunk.

Systems of irrigation are a mere outcome of circumstances in different countries and different localities in the same country. The grape-vine orchards in Northern and Central California where water supply is plentiful are simply flooded in long strips of beds, the tree row being in the centre of the bed. In the new virgin soils of these vine-growing areas no necessity has yet been felt to manure or fertilise the orchards and there is no danger of leaching the fertilisers due to heavy overhead flooding in large basins. On the other hand, in more arid zones of South California leaching of nitrogenous fertilisers in Citrus orchards is a great problem to be guarded against. In the arid areas, the furrow method of irrigation is found to prevent leaching of fertilisers very efficiently. Flood irrigation is especially desirable in fine silty soils where there is any amount of objectionable salts or alkali present as in the soils of the lower Indus Valley, Rajputana and in many places in the U. P. and the Central Provinces.

In such alkali soils flooding in basins can be used to great advantage to leach down the harmful salts down below the root zone of the trees.

[10] Hendrickson, A. H., and Veihmeyer, F. J., "Irrigation experiments with grapes," *Proc. Amer. Soc. Hort. Sci.*, 1931.

Orchards planted on more sandy soils should not be flood irrigated as these soils have a tendency to take too much water at the upper head. The irrigation furrows on sandy soils should be necessarily short as long furrows in porous soils waste much water by deep percolation (much far below the root zone of trees) in their upper lengths.

In the arid zones of southern California where irrigation water has to be brought from long distances, very elaborate and economical devices have been constructed to give a measured quantity of water just sufficient to wet the required depth in a definite period. In the Citrus orchards of California water is no longer conveyed in open dirt ditches but it is most economically carried through underground pipe lines. As the water reaches the orchard it is taken from the main pipe line and distributed by underground pipes to each tree row. Underground pipe lines are laid deep enough (3′—5′) to be out of the way of cultivation implements and are provided with concrete hydrants or stand pipes for each row of trees. These hydrants are usually fitted with valves for regulating the flow of water into them and have adjustable gates through which the water flows to the irrigation furrows. The flow of water is so regulated by the gates as to control its very gradual seepage into the sides and bottom of the furrows. The water reaches the end of the furrow in about one-fourth the time of the period of an irrigation. The practice in many groves is to run water to the end of the furrow quickly and then reduce the flow for the rest of the period of irrigation. Penetration at top and bottom run is thus about the same. A ditch is provided at the other end of the furrow to drain away the surface water running through the furrow during the period of irrigation. This drained water is re-used by pumping back for irrigating in the same orchard or for any other useful purpose. In California, application of water by this system, over a period of about 48 hours, is found sufficient for completley wetting the soil of the root zone of Citrus trees.

While discussing the adoption of different methods of irrigation as circumstances would demand, the unique practice of Island irrigation as followed in the flood swept area of South East China need a special mention. The type of Agriculture found in this country is exceedingly well adopted to the low lying, water-logged soils where rice is the chief staple crop cultivated and rotated with vegetables. The fruit and vegetable cultivation in this country comprises a very elaborate and intensive system of canals, dikes, raised beds and ditches.

The soils of these areas are of alluvial origin and their texture is very fine, being mostly clay, silt or fine loam. Most of these soils are very deep and of high organic content. The whole delta region is subject to heavy floods when the rivers are high in the summer monsoon and the ocean tide holds back their waters. The fields and houses of the area are protected by numerous mud dikes which are specially built round the land to keep back the floods. The inner protected delta land is used for the cultivation of rice, lotus and other water crops while the surrounding dikes are planted with fruits like Lychee, Lungan, Oranges, Peaches, and Papayas. Often the inner rice land is reclaimed for fruit and vegetable culture by dividing the low lying land into a system of raised beds and ditches. The raised beds, 15 to 20 feet wide, are planted out with fruits and the ditches 2½ to 3 feet wide serve as irrigation channels as well as drains. Water is taken from the canal into the ditches at the time of high tide in the river and is driven out when it is low. To begin with, the ditches are very narrow and shallow and the beds are wide; but the beds gradually get narrower and higher by the gradual process of widening and deepening the trenches which get filled up by the deposited silt and have to be cleaned out each year and the mud smeared back over the beds as a fertiliser.

By the time the trees reach their most productive age, the constant deepening and widening of the trenches reduces the width of the bed to about 15 feet and depth of the trenches becomes 5 to 6 ft. Often the water table in such soils is fairly high and the water rises above to the tree roots on the raised beds by capillarity from the wide and sufficiently deep trenches which hold standing water for a considerably long time. The beds are kept scrupulously clean by weeding and other shallow cultural operations by hand. In a system of this kind of irrigation and cultivation, the soils however clayey and retentive, do not suffer from the packing action of overhead watering or hard pans brought about by tillage operations in irrigated lands in other parts of the world. Both sides of the raised bed having been provided with open drains there is absolutely no danger of oxygen deficiency in spite of the continuous capillary rise of water from the permanent water table of the beds close at hand or the flood waters standing in the ditches for a considerably long period. No effort is made to maintain any kind of mulch except that the muck from the trench smeared over the bed is allowed to crack. The constant supply of water in the trenches makes unnecessary any effort to prevent evaporation.

This system could doubtless be employed to advantage in some of the swampy areas in deltas of our big rivers which are low and subject to a flood or to submersion at high tide from the sea. In this regard we can draw much inspiration from the unique orcharding of the world's best pummelo gardens in Ban Mai in Siam situated in the delta of the Tachin River located about 50 kilometers southwest of Bangkok.

According to the investigations of Prof. Groff[11] of the Lingnan University, Canton, China, during the dry weather (between January and July) the tidal flow extends far inland and in the lower part of the river the water becomes extremely salty containing as much as 2% sodium chloride (very nearly approaching sea-water containing 2.7% sodium chloride). In this region the type of cultivation and irrigation is the same as the system of water farming of raised beds and ditches as followed in Southeast China. It is in these salty swamps that the world famous seedless pummelo called "The Kao Pan" attains excellence of quality unrivalled in any other part of the world.

[11] Groff, G. W., and Reinking, O. A., "The Kao Pan Seedless Siamese Pummelo and its culture," *The Philippine Journal of Science*, October 1921, **19**, No. 4, Manila.

Sugar Industry of India (1934-35).*

UNLIKE in the previous year the world sugar consumption in 1934–35 exceeded the total sugar production by about 730,000 tons. This curtailment of sugar production is mainly attributed to the measures adopted by the U.S.A. Government in introducing the quota system of production. Java has again suffered heavily. Conditions in India during this year were however satisfactory and the industry kept up its progress. Unfavourable weather conditions and diseases affected the crop in the U.P. and the Punjab but for all-India there was an increase of about 40,000 acres in the land under cane cultivation and a 4 per cent. increase in the raw sugar output.

Of the total 142 sugar factories built for operation, 130 worked in 1934–35 while in the previous year only 112 factories operated. As a result of this there was an increase of 124,150 tons in the total sugar produced direct from cane. We, therefore, find an increase of 30 per cent. in the number of factories and a 16 per cent. increase in the sugar output over the previous year's figures.

The highest recovery for all-India during 1934-35 was 11.10 as against 10.98 in the previous year but there was a decline in the average recovery from 8.80 in 1933–34 to 8.66 in 1934–35.

Technical and agricultural work continued its progress in the experimental stations at Coimbatore and Pusa and also in the different provinces. This work was chiefly confined to cane breeding technique and varietal experiments. Experiments on the open pan system and trials of small plants were carried out in Bihar and Orissa and Bengal while in Bombay sugar was made by this process in eight places on the Deccan Canals. Cultural experiments on five varieties of beet in the N.W.F. Province showed German (22) to be the heaviest yielder.

The total value of sugar machinery imported into India during 1934–35 was about one crore of rupees while in the previous year it was 3.36 crores.

It should be noted that the total '*gur*' production in this year was 3,692,000 tons and was the highest figure for the last ten years.

In the year under review the total sugar produced from cane, from '*gur*' refining and by the indigenous processes amounted to 768,115 tons. The imports of sugar declined at the same time and were less by 38,000 tons than in the previous year. This decline in the imports from Java alone was 18,000 tons.

Java has suffered seriously by the loss of her Indian and Japanese markets and as a result had to effect drastic reductions in her sugar industry. The number of factories that operated, the acreage under cane cultivation and the quantity of cane harvested in the year 1934–35 were less than 50 per cent. of the previous year's figures.

Because of her preferred position in the American market Cuba did not suffer much. Cuban sugar industry was chiefly influenced by the reduction of tariffs and the introduction of quota system of production by the U.S.A. Government.

The future of Indian sugar industry continues to be bright. In the next year (1935–36) it is expected that the production will be 106,000 tons of sugar more than in 1934–35. There has not been any damage to the U.P. crop as in 1934–35. The time seems to be opportune to achieve a more settled market by finding out a uniform basis for grading sugars and adopting sale contracts more equitable between the manufacturer and the merchant.

G. GUNDU RAO.

* Review by R. C. Srivastava, Supplement to the *Indian Trade Journal*, May 21, 1936, published by the Manager of Publications, Delhi.

Lady Tata Memorial Trust.

THE Trustees of the Lady Tata Memorial Trust have announced the award of the following scholarships and grants for 1936—37. The international awards have been made mainly for the promotion of researches on the diseases of the blood with special reference to Leucæmias. Dr. Charles Oberling, Paris; Dr. Julius Engelbreth Holm, Copenhagen; Dr. Lucy Wills, London; Dr. Max Otto Kaalund-Jorgensen, Copenhagen; Prof. Eugene L. Opie of the Cornell University; Dr. Phil Karl Hinsberg, Berlin and Prof. J. McIntosh, London, are the recipients.

Indian Scholarships for the investigation of problems having a bearing on the alleviation of human suffering have been awarded to the following:—(1) Mr. M. C. Nath, M.Sc., to continue the chemical and biological analysis of proteins of Indian Foodstuffs, (2) Mr. R. Chakraborty, M.Sc., to continue the investigation of nutritional problems of Indian Foodstuffs with special reference to Vitamin C, (3) Mr. N. B. Das, B.Sc., to continue the work on the oxytoic harmone and on oxidation and reduction of systems in the body, (4) Mr. T. N. Ghosh, M.Sc., for research on the preparation of New Anti-malarials, (5) Dr. B. K. Nandi, M.Sc., Ph.D., A.I.C., for work on the synthesis of antimalarials of the plasmochin and atebrin types, and (6) Mr. H. S. Mahal, M.Sc., to investigate the rôle of "Choline Esterase" and to continue the work on anthelmintic drugs.

Science Notes.

Loss of Spirit Due to Evaporation under Indian Conditions.—Mr. K. R. Ganguly, Government Laboratory, Agra, writes.—Experiments, the results of which are given in Table I, were carried out to see how far spirits lose in strength under Indian conditions, when kept in bottles with faulty or loose stoppers. The nature of loss studied in this laboratory, situated at a place where almost throughout the year a very dry atmosphere prevails, may be taken as more or less the highest in India that may occur due to negligence such as keeping the bottle in an almost open condition due to faulty corks.

TABLE I.

a—Bottles kept tightly closed with corks.

b—Bottles kept open (plugged with loose cotton wool to prevent dust).

(Results expressed in % proof)

Days	I		II		III		IV		V		VI	
	a	b*	a	b*	a	b*	a	b*	a	b*	a	b*
Starting day ..	9·3	9·3	29·6	29·6	49·7	49·7	63·5	63·5	100·0	100·0	139·9	139·9
17th ..	9·3	8·9	29·6	28·8	49·7	48·5	63·5	61·9	100·0	98·9	139·9	139·2
32nd ..	9·5	8·8	29·6	28·2	49·6	47·5	63·5	60·9	100·0	98·0	139·9	138·7
51st ..	9·5	8·6	29·6	27·6	49·6	46·6	63·5	59·6	100·0	97·0	139·9	138·0
66th ..	9·4	8·3	29·6	26·9	49·6	45·4	63·5	58·3	100·0	95·7	139·9	137·3
81st ..	9·4	8·2	29·6	26·4	49·5	44·3	63·5	57·4	100·0	94·9	139·9	137·0
111th ..	9·4	7·7	29·5	25·3	49·5	42·5	63·5	55·3	100·0	92·9	139·9	136·1
148th ..	9·2	6·7	29·2	23·2	49·2	39·5	63·4	51·7	99·8	89·7	139·6	134·2
298th ..	9·1	5·4	29·2	19·8	49·2	34·6	63·2	44·2	99·8	81·9	139·6	130·6

*Mean of duplicates.

Plain country spirits of six different strengths, *i.e.*, 9.3, 29.6, 49.7, 63.5, 100.0 and 139.9 per cent. proof were kept in reputed quart bottles, which are stamped 'U. P. Excise' and are used in bottling country spirits in the United Provinces of Agra and Oudh. The dimensions of these bottles were: body, 8″; neck, 4″ and inner diameter of the mouth, 0.9″ to 1.0″.

The strengths under I and II were taken to study the condition of very dilute spirits such as obtaining in feints. The strengths under III and IV nearly correspond respectively to the minimum and the maximum issue strengths of the United Provinces. The strengths under Nos. V and VI correspond nearly to the strength of final products of distillation used for potable purposes by pot and patent stills respectively.

Rectified spirit of 60.0 O. P. strength was diluted with distilled water in order to obtain the different alcoholic strengths to start with. In the beginning each bottle was filled with 758 c.c. (1/6th of a gallon) of spirit; this liquid nearly filled up the bottles to the mouths.

The strengths were determined at the start and at different subsequent stages from specific gravities measured by a Pyknometer at 60° F.

The results of these experiments show that the percentage loss in *proof gallonage* is the highest in the case of the lowest strength and the lowest in the case of the highest strength spirit, but loss in *proof strength* is the highest near about the United Provinces' maximum issue strength. This is shown by the following figures deduced from those given in the Table I.

TABLE II.

	Maximum per cent. loss in *proof gallonage* due to deterioration of *proof strength* in about one year	Maximum loss in proof strength in about one year
No I	41·9	3·9
No. II	33·1	9·8
No. III	30·4	15·1
No. IV	30·4	19·3
No. V	18·1	18·1
No. VI	6·6	9·3

These results would be of interest in deciding questions of alleged evaporation, where wilful dilution is suspected.

Further experiments are being carried out to find out directly the vapour pressure of different strengths of alcohol-water solutions at ordinary temperatures.

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A New Type of Vasculum for the Indian Climate.—Dr. F. R. Bharucha, writes from Bombay under letter, dated 29th April 1936:—Every field-botanist in India comes to realise very soon that the tin vasculum (black-japanned outside) ordinarily used in the West is almost completely useless for the Indian climate. It is my experience that many plants and particularly small flowers of the Papilionaceæ order gathered

during the day, dry up beyond recognition by the time they are taken to the laboratory.

Hence some experiments were undertaken to devise a vasculum most suited to Indian conditions. Tin was preferred to aluminium for making the vasculum as it lends itself to soldering and is not easily corroded by water and alkalies which are present in the soil attached to the roots of plants.

The vasculum was lined inside by a thin white asbestos sheet about 1/16in. thick. The lid of the vasculum which was made tight-fitting was also lined with the same material. To test its efficiency delicate flowers, like the garden Phlax and Canna, were placed inside the vasculum along with a thermometer. A control vasculum without any asbestos lining was set up. It was found that the flowers in the experimental vasculum remained fresh for a long time. By introducing a wet sponge in the asbestos-lined vessel it was found that the flowers remained fresh the whole day, even on days of intense heat.

In the course of these experiments it was noted that though the thermometer in the asbestos-lined vasculum recorded almost as high a temperature as in the control one, the flowers remained fresher in the former than in the latter. Two conclusions may be drawn: (1) that primarily a humid atmosphere is necessary for maintaining the freshness of the flowers, and (2) that a direct contact with the outside cover of the vasculum affects the flowers considerably; an intervening layer of a material of poor conductivity prevents flowers from wilting. A lighter vasculum can be made by lining it with limpet sheet instead of ordinary asbestos but this would cost double the price. To prevent tin from rusting the outside of the vasculum can be specially painted to an aluminium finish.

* * *

Archæological Discoveries in Kotah State.—In the course of a tour of archæological exploration organised under the auspices of the Kotah Government, Dr. A. S. Altekar, Manindrachandra Nandi Professor of Ancient Indian History and Culture in the Benares Hindu University, made several important discoveries. The most important among these is the discovery of three sacrificial pillars each bearing a record, dated in the year 295 of the Vikrama era, and announcing the performance of the *Tri-rātra* sacrifice by the sons of a Maukhari ruler. The earliest Vikrama era inscription, so far known, is dated in the year 282; so the new inscriptions are the second earliest records in the Vikrama era. So far the antiquity of the Maukharies could not be taken to a date earlier than the 5th century; the new records show that they were ruling as important chiefs a couple of centuries earlier and so far to the west as the Kotah State. These pillars were discovered in the village Badra.

Three Gupta period inscriptions were discovered, two at Charchoma and one at Mukundara. One of these contains an Ayurvedic prescription, the second records the foundation of a Siva temple and the third mentions a chief who is known to have died while fighting with the Hunas.

In the Lakshmī-Nārāyana temple at Shergadh, two very interesting Paramāra records were discovered. These belong to the 11th century A.D. These records show that Lakshmī and Nārāyana are interlopers in their present abode which was originally built for Somanātha. When and why the latter gave place to the former, we do not know. The inscriptions describe a series of donations given to the Somanātha temple by the rulers and private individuals for different purposes connected with the temple worship.

Shergadh is now a deserted village, but during the period 800–1200 A.D., it was the headquarters of a flourishing district, as its old name *Koshavardhana*, "the increaser of royal revenue", shows. Several Jain temples and Buddhist monasteries existed there during this period and numerous records mentioning grants to these were discovered at the place. Another place, once flourishing but now deserted, was discovered on the tiger-haunted forests in the vicinity of the village Bilas. This forest is literally studded with old temples, sculptures and images. One of these was dedicated to twenty-four Jaina *Tirthankaras*, as the extant riches in the dilapidated temple show. Bhimagadh was another old flourishing fort, now altogether deserted. In two temples in the fort were discovered two inscriptions mentioning King Bhīma, who had founded the city and fort.

The discoveries made during the tour show that from about the beginning of the Christian era down to the advent of the Muslim power, the territories of the Kotah State were inhabited by cultured people, who lived harmoniously in spite of their following different religions and who had made a remarkable progress in sculpture, architecture and literature.

* * *

The Date of Bhārata Battle.—A paper of considerable interest on the date of the Bhārata Battle, was read by Dr. P. C. Sen Gupta, at the ordinary monthly meeting of the Asiatic Society of Bengal, held on Monday, 1st June. The date of the battle is of importance for fixing the chronology of the *Vedas*, *Brāhmanas* and the *Upanisads*. The previous researches on the subject have all led to inconclusive results. According to tradition, the date of the event has been severally given as 3102 B.C. (Āryabhata), 2449 B.C. (Vrddha Garga) and 1421 B.C. (the astronomical writers of the *Purānas*). Dr. Sen Gupta, from a critical study of the astronomical references in the *Mahābhārata* itself, comes to the conclusion that the date of the battle is 2449 B.C.

In the paper, Dr. Sen Gupta cites a system of consistent astronomical references from the *Mahābhārata* from which he attempts an "approximate solution of the problem as one on conjunction of the moon with the sun and some fixed stars. He finds that the approximate position of the summer solstitial colure of the year of the Bhārata Battle passed through the star *Regulus*, whence the year comes out to be 2350 B.C.—a result which fairly agrees with the tradition ascribed to Vrddha Garga that Yudhisthira became King in 2449 B.C. He then examines the year 2449 B.C. astronomically by a consideration of the mean motions of the sun and the moon and proves that the lunisolar phenomena of the *Mahābhārata* references did actually happen in 2449 B.C. He next calculates the apparent longitudes of the sun, the moon, and some stars

for some days of the year 2449 B.C. and shows conclusively that the fight began on the 14th October and lasted till the 31st of the same month and that Bhīṣma expired on the 20th December, one day after the sun had reached the winter solstice. So far as our knowledge goes these *Mahābhārata* references have not been used in any other previous researches. The author has supplemented his paper by citing some other *Mahābhārata* references showing that there was a time in the history of Hindu India, when the summer solstitial colure passed through the star *Regulus* and the vernal equinoctial year through the star group *Pleiades*, for which the mean date is 2350 B.C.

At the same meeting the following exhibits were shown and commented upon: (1) Chintaharan Chakravarti: *Newly Acquired Manuscripts on the Cult of Kubjikā*. (2) M. Hidayat Hosain: *A Persian Stencilled Wall-hanging Picture said to represent "Umar Khayyām"*. (3) Percy Brown: *A Metal Figurine of a Dancer*.

The following candidates were balloted for as Ordinary Members.—Mr. Jitendra Mohan Sen, M.Ed., B.Sc., F.R.G.S., F.N.I. (2) Khan Bahadur Alfazuddin Ahmad, M.A.

* * *

Deutsche Akademie Scholarships.—The Indian Institute of the Deutsche Akademie has announced the award of seventeen new scholarships for the academic year 1936–37 to the following Indian graduate students who are to carry on higher studies in various German Universities:—*Medicine:* Miss Usha Haldar, M.B.B.S. (Delhi), and Mr. G. S. Guha, M.B. (Assam); *Mathematics:* Mr. Suprasanna Sengupta, M.Sc. (Rangoon); *Indology:* Mr. Aryendra Sharma, M.A. (Allahabad), and Mr. R. N. Dandekar, M.A. (Poona); *Chemistry:* Mr. N. K. Seshadri Iyengar, M.Sc. (Bangalore), Mr. Basudeb Banerjee, B.Sc. (Calcutta), Mr. N. K. Saha, M.Sc. (Allahabad), and Dr. A. K. Dutta, D.Sc. (Calcutta); *Engineering:* Mr. N. Anjaneyulu, B.Sc. (Benares), and Mr. Nand Lall Gulali, B.Sc. (Benares); *Archæology:* Mr. T. Balakrishnan Nayar, M.A. (Annamalainagar); *Veterinary Science:* Mr. P. C. Nag, G.B.V.C. (Sylhet); *Agriculture:* Mr. Panchanan Maheshwari, M.Sc., D.Sc. (Agra); *Mining:* Mr. B. S. Sanjeeva Reddi (Colarado, U. S. A.); *Fine Arts:* Miss Sheila Bannerjee (Calcutta); *Economics:* Mr. Bashesharnath Tandon, M.A. (Meerut).

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Radio Research Board for India.—At the invitation of Prof. S. K. Mitra, a number of distinguished scientists, including representatives of radio research workers from Australia and Canada, met at London to consider the question of forming a Radio Research Board for India. Prof. S. K. Mitra, who was in England to acquaint himself with the latest developments in Radio Research, in the course of his speech, emphasised the need for a co-ordinate organisation with adequate funds at its disposal for conducting radio investigation in India. Prof. Mitra said "There are men available for such work in the Universities, men who by their training are particularly gifted for such type of work. But without the co-operation of Government Departments, like the Air-Ministry, the Meteorological and the Postal Departments, the Universities, where alone such work is now being carried on, cannot successfully conduct such investigations. The nature of the most helpful co-operation that is necessary is best exemplified by the *British Radio Research Board* which maintains a close touch between the various Government Departments and the Universities." Prof. E. V. Appleton, King's College, London, supported the need for a Board of the type envisaged by Prof. Mitra. Sir Frank E. Smith mentioned that various problems such as that associated with the field strength of received signals at different times of the day and at different seasons of the year with different wavelengths and with different transmitting aerials, are of a *local* nature, which can be solved by work in the country desiring the information. If the Research Board is founded in India, it will be of help, not only to India, but to the international Research work now being conducted in Great Britain and other countries. The British Radio Research Board will be glad to co-operate with any research organisation which might be established in India. Prof. A. S. Eve (Canada) and Prof. T. H. Laby (Australia) also emphasised the need for the formation of such a Board which will bring engineers and physicists together in solving both theoretical and practical problems.

* * *

The Indian Anthropological Institute.—In response to a general desire among the leading anthropologists of India, a Central Anthropological Association has been formed with its headquarters in Calcutta under the name of the Indian Anthropological Institute. Dr. J. H. Hutton, D.Sc., C.I.E., I.C.S., is the President, and Dewan Bahadur L. K. Ananthakrishna Aiyar and Rai Bahadur Sarat Chandra Roy are the Vice-Presidents of the Institute. Mr. K. P. Chattopadhya is the Treasurer and Dr. B. S. Guha and Dr. Panchanan Mitra are the Secretary and the Joint Secretary of the Institute, respectively. The Institute proposes to hold periodical meetings and promote anthropological research in India on scientific lines and publish a half-yearly journal.

* * *

The Central Jute Committee.—It has been decided to set up a Central Jute Committee under the Central Government of India. The function of the Committee will be to undertake agricultural, technological and economic research, the improvement of crop forecasting and statistics, the production, testing and distribution of improved seed, enquiries and recommendations relating to banking and transport facilities and transport routes and the improvement of marketing in the interests of the Jute Industry in India. The Committee will also be required to advise the Local Governments concerned on any points which may be referred to it, provided the subject-matter of the reference falls within the prescribed functions of the Committee.

The Secretary of the Committee will be appointed by the Governor-General in Council, and he will not be a member of the Committee. The Government of India have decided to finance the Committee for the time being by grants from the Central Revenues. The grants will not exceed

5 lakhs of rupees in a year and for the year 1936–37, a grant of Rs. 2½ lakhs has been made.

The Headpuarters of the Committee will be Calcutta.

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Sir George Anderson has been permitted by the Government of India to relinquish his duties as Education Commissioner with the Government of India. Mr. Arthur Henderson McKenzie has been appointed to the post.

* * *

Deterioration of Structures in Sea-Water (Fifteenth Report).—His Majesty's Stationery Office. Price 12*s.* 6*d.* Post Free 13*s.* The problem of protecting structures against deterioration in sea-water has been exhaustively studied by a Committee of the Institution of Civil Engineers for over fifteen years. During that time, observations have been made in several parts of the world on the action which sea-water has exerted upon a wide variety of structural materials. The present volume constitutes an authoritative general survey of the problem as a whole and of the results achieved in the work already undertaken. The four main sections of the Report are :— Preservation of Timber; Corrosion of Steel and Iron; Protection of Steel and Iron by means of Paint and other Preservatives; and Deterioration of Reinforced Concrete. The Report is accompanied by a large number of tables and plates.

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Yellow Fever.—The operation of direct air services from Central and East Africa to India has brought India within the reach of yellow fever. There has not been any case of yellow fever in India, but extreme precautions are essential particularly as the mosquito, *Stigomiya fasciata*, which is the transmitter of yellow fever virus, is common in most parts of India, particularly in the coastal tracts. The Government of India have taken up the matter for consideration and by a new Act, the air-port authorities at Karachi are empowered to take preventive measures similar to those which are taken by seaport authorities.

* * *

Oil and Soap Research.—Important decisions were reached at the meeting of the Oils and Soaps Committee of the Industrial Research Council, held during the first week of this month. According to an *Associated Press* report the Committee first surveyed the work done on Oils and Soaps and also the equipment and staff in different laboratories. Future research necessary was then considered and a programme was agreed to. The items decided were distributed amongst the different laboratories. They include work on fatty oils, including examination of the character of oils pressed from different races of linseed and examination of the best method of preparing paint oils, boiled linseed oil and stand oil and also the study of development of rancidity in oil.

Regarding soap, problems considered were the selection of soap stocks mixtures of fats used for soap-making, cause and cure of certain defects, *viz.*, rancidity and sweating and the study of soap detergency, *viz.*, cleansing power.

In the field of essential oils, it was thought that a selection be made from among the numerous essential oil plants known to grow in India. Some of the most important plants were selected for study, each to be examined in one or other of the laboratories represented.

One other important matter which the Committee decided was the utilisation of vegetable oils for lubricating purposes. Whether this would be practicable or not remains to be tested. Vegetable oil-producing industry in India is very large and besides extensive home consumption, India exported in 1934–35, Rs. 30 lakhs worth of vegetable non-essential oils.

* * *

The Effects of Storing Cotton Bales in the Open and Inside a Shed at Karachi.—In his investigation into "The effects of storing cotton bales in the open and inside a shed at Karachi", Dr. N. Ahmad, Director of Indian Central Cotton Committee's Technological Laboratory, Matunga, reveals some interesting facts and figures.

With the increase in the cotton export trade at Karachi, there has been a corresponding increase in the number of cotton bales stored prior to shipment, a small percentage of which could only then be accommodated owing to the paucity of sheds; the remainder were exposed to the action of salt, ozone in the sea, air, sunshine and rain. The author selected the three important trade varieties, namely, Punjab-American, Punjab-Desi and Sind-Desi for his invesitgation and analysed the effect of this exposure and the consequent deterioration caused by bacteria and fungi on the cotton fibre by applying the method of analysis of variance. He found that the average deterioration in spinning quality over a period of 18 months was 13.6% for Punjab-Desi, 15.6% for Sind-Desi and 5.2% for Punjab-American. The rate of deterioration was different for different cottons.

* * *

Quality of Sugar Manufacture in India.—A review of the quality of sugar manufactured by central sugar factories and refineries during the season 1935–36 has been published by Mr. R. C. Srivastava (*Indian Trade Journal*, Jan. 4, 1936, 1044). The quality is judged by two physical characteristics, colour and size of grain of sugar. About 25 per cent. of the factories in India produce one grade sugar only; but the most common practice is to produce two grades. The commonly manufactured qualities of crystal sugar in India at present are those having fine grain and medium or inferior colour. In the large grained sugars examined, the crystals were dull in appearance. As a rule the crystals showed mixed grain of varying sizes and irregular shapes; only a few samples showed well-defined edges. It may be remarked here that a feature of all samples of imported sugars was the uniformity in the size of grain combined with a good lustre.

* * *

Study of Malaria Problems.—The League of Nations Malaria Course was inaugurated on Monday, April 27, at the King Edward VII College of Medicine, Singapore (see *Curr. Sci.*, 1936, **4**, 542). The Hon'ble Mr. A. S. Small, Officer administering the Government, in welcoming the delegates said "In Singapore and Malaya, a great deal of work has been done in connection with malaria research and we in

Malaya are proud of the fact that, to a great extent, we have played a leading rôle in such of the work that has been done throughout the world. I understand that the problem of malaria control varies in different countries, but it seems to me that there must be certain guiding principles which are common to the problem in all the places and a course such as this where you are enabled to exchange your ideas, must tend, I think, to increase your experience and knowledge and help you to a favourable result in dealing with the problems that may face you in your country."

The programme of lectures include laboratory work at the College of Medicine with clinical examinations at the Government Hospitals supplemented by practical field demonstrations in and around Singapore Island. The candidates then proceed in groups either to the Federated Malay States or to Indo-China or to Netherlands Indies, for a three weeks' intensive study of the measures for the control of malaria and their different conditions.

* * *

The London School of Economics and Political Science.—A special course on Colonial Administration, which is designed for persons interested in the problems of Colonial Administration, including those actually in contact with such problems, whether as administrators, educationalists or missionaries, will be given at the London School of Economics and Political Science, University of London. It includes seminars for discussion in addition to formal lecture courses in anthropological, administrative, legal and economic aspects of colonial administration and includes comparative studies of the principal colonial systems. The session covers the Lent and Summer terms—11th January to 25th June 1937—and represents a full-time programme of study. Applications for admission should be made to the Secretary of the School, Houghton Street, Aldwych, London, W.C. 2.

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Death occurred on 9th June of Dr. A. Moffat, former Professor of Physics, Madras Christian College. Dr. Moffat came to India in 1892 to join the staff of the College. He was a very popular professor and was a member of the Senate, Board of Studies and Syndicate of the Madras University. After retirement, he served the Union Christian College, Alwaye, in an honorary capacity. Until April last, Dr. and Mrs. Moffat were residing at Bangalore. Dr. Moffat went to England for medical treatment where he died.

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Statistical Abstract for British India, 1923–24 *to* 1932–33.—We have recently received from the Manager of Publications, Delhi, the statistical abstract covering 951 pages (price Rs. 5–2–0). The publication also includes statistics relating to certain Indian States. The topics dealt with are divided into :—Area and Population ; Justice, Police and Prisons ; Registration ; Finance ; Coinage and Currency ; Banks ; Municipalities, District and Local Boards ; Education ; Press ; Co-operative Societies ; Agriculture and Land Revenue ; Forests ; Port Trusts ; Emigration ; Pilgrims ; Vital Statistics ; Medico-Legal investigations ; Mental Hospitals ; Railways ; Road Communications ; Foreign Trade ; Coasting Trade ; Ships Built and Registered ; Joint Stock Companies ; Life, Fire, Marine and Miscellaneous Insurance Companies ; Post Offices ; Telegraphs and Telephone ; Meteorology ; Irrigation Works ; Prices of Staple Commodities ; Industries ; Fabrics ; Trade Unions ; Patents and Designs and Mineral Production. The publication is well indexed.

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ANNOUNCEMENT.

His Majesty, the King-Emperor, has been graciously pleased to grant permission to the Asiatic Society of Bengal to use the title "Royal" before its name.

The Society, therefore, will henceforth be known as the "*Royal Asiatic Society of Bengal*".

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Seventh International Congress of Genetics.—In accordance with the resolution of the International Committee elected by the Sixth International Congress of Genetics and with the resolution of the Government of the USSR, the Seventh International Congress of Genetics will take place in the USSR. It is planned to hold the sessions in Moscow in the second half of August, 1937.

The Organisation Committee of the Congress is as follows :—

President.—A. I. Muralov (President of the Lenin Academy of Agricultural Sciences of the USSR) —Moscow.

Vice-Presidents.—N. I. Vavilov (Vice-President of the Lenin Academy of Agricultural Sciences of USSR)—Leningrad ; V. L. Komarov (Vice-President of the Academy of Sciences of the USSR)—Moscow.

General Secretary.—S. G. Levit—Moscow.

Titles and abstracts should be directed to the Organisation Committee and should be in their hands by February 15th, 1937.

The Organisation Committee will appreciate suggestions concerning the programme and other matters pertaining to the Congress.

For all questions in connection with the Congress write to :

ORGANISATION COMMITTEE of the Seventh International Congress of Genetics, Institute of Genetics, Academy of Sciences, Bolshaya Kaluzhskaya 75, Moscow, USSR.

Telegrams : MOSCOW GENETICA.

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It is announced that the Fifth Conference of the All-India Ophthalmological Society will be held in Lahore from the 20th to 22nd December, 1936, under the presidency of LT.-COL. E. O'G. Kirwan, I.M.S. One Session of the Conference will be devoted to a discussion on the ocular disorders in diabetes.

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We acknowledge with thanks the receipt of the following :—

"Actualités Scientifiques et Industrielles," Nos. 134, 135, 137, 142, 150, 155, 158, 177, 222, 224, 234, 236, 249, 250, 253, 256–259, 261–263,

265–266, 270, 273–274; 278–280; 282–286; 288–294, 297–298, 302, 304–35, 307, 314, 318–319, 323.

"The Agricultural Gazette of New South Wales," Vol. XLVII, Pt. 5, May 1936.

"Journal of Agricultural Research," Vol. 52, Nos. 3 and 4.

"The Allahabad Farmer," Vol. X, No. 3, May 1936.

"Journal of the Royal Society of Arts," Vol. LXXXIV, Nos. 4353–4356.

"Biochemical Journal," Vol. 30, No. 4, April 1936.

"Journal of the Indian Botanical Society," Vol. 15, No. 3, June 1936.

"Journal of the Institute of Brewing," Vol. XLII (XXXIII), No. 5, May 1936.

"Chemical Age," Vol. XXXIV, Nos. 878–881.

"Journal of Chemical Physics," Vol. 4, No. 5, May 1936.

"Journal of the Indian Chemical Society," Vol. 13, No. 3, March 1936.

"Berichte der Deutschen Chemischen Gesellschaft," Vol. 69, No. 3.

"Journal de Chemie Physique," Vol. 33, No. 5.

"Transactions of the Faraday Society," Vol. XXXII, No. 5, May 1936.

"Indian Forester," Vol. LXII, Nos. 5–6, May-June 1936.

"Indian Forest Records," Vol. II, Part I.—'Silviculture: A Glossary of Technical terms for use in Indian Forestry'.

"Forschungen und Fortschritte," Vol. 12, Nos. 13–15.

Goverment of India Publications:—Miscellaneous Bulletin No. 6. (Imperial Council of Agricultural Research)—"Bee-Keeping," by C. C. Ghosh, III Revised Edition.

"Indian Trade Journal," Vol. CXXI, Nos. 1560–62.

"Scientific Reports of the Imperial Institute of Agricultural Research, Pusa (including the Reports of the Imperial Dairy Expert, Physiological Chemist and Sugarcane Expert), 1933–34."

"Annual Report of the Imperial Council of Agricultural Research for the year 1934–35."

"Quarterly Bulletin of the Health Organisation, League of Nations," Vol. V, No. 1, March 1936.

"Communications from the Kamerlingh Onnes Laboratory of the University of Leiden" Nos. 235-238 and Suppl. No. 77, to Nos. 229–240.

"Technological Bulletin" Series A, No. 30, March 1936 (Indian Central Cotton Committee). 'The Effect of Storing Cotton Bales in the Open and Inside A Shed in Karachi,' by Nazir Ahmed.

"Scripta Mathematica," Vol. IV, No. 1, January 1936.

"The Calcutta Medical Journal," Vol. 30, No. 11, May 1936.

"Medico-Surgical Suggestions," Vol. 5, No. 5, May 1936.

"Dominion of Canada—18th Annual Report of the National Research Council containing the Report of the President and Financial Statement, 1934–35."

"International Institute of Agriculture," Rome —"Monthly Bulletin of Agricultural Science and Practice," Vol. 27, No. 4, April 1936.

"Proceedings of the Association of Economic Biologists, Coimbatore," Vol. III, 1935.

"Proceedings of the National Academy of Sciences, India," Vol. VI, Pt. II, May 1936.

"Review of Applied Mycology," Vol. 15, No. 4, April 1936.

"Journal of the American Museum of Natural History," Vol. 37, No. 5, May 1936.

"Journal of the Bombay Natural History," Vol. 38, No. 3, and Index to Vol. 38, Nos. 1 and 2.

"Nature," Vol. 137, Nos. 3469–3472.

"Journal of Nutrition," Vol. 11, No. 4.

"Journal of Research, National Bureau of Standards," Vol. 16, No. 1, Jan 1936.

"Ceylon Journal of Science," Section D, Vol. IV, No. 1.

"Science and Culture," Vol. I, No. 13, June 1936.

"Arkiv fur Zoologie," Vol. 28, No. 2.

CATALOGUES.

Universum Book Export Co., 1936, Catalogue II.

Hilger Publication No. 244 (Messrs. Adam Hilger Ltd.).

Everest Expedition.

MOUNT Everest, the world's highest peak, has once more defied man's attempt to climb its summit. The early advent of the monsoon and the heavy fall of snow rendered all heroic efforts unsuccessful and a retreat of the adventurous expedition has been officially announced, but this unsuccessful attempt has yielded much valuable information. The party under the leadership of Mr. Ruttledge have discovered a new point of attack which would be of great value on a future occasion.

Academies and Societies.

Indian Academy of Sciences:

May 1936. SECTION A.—SH. NAWAZISH ALI AND R. SAMUEL: *Absorption Spectra of Tetra-Alkyl Ammonium Salts. Contributions to the Theory of Co-ordinate Linkage IX.* Some molecules of tetra-alkyl ammonium iodide possessing a true covalent N-I bond exist in equilibrium with the dissociated molecules of the salt. This indicates that nitrogen under favourable conditions can be penta-covalent in agreement with a pair-bond theory of valency. K. C. SUBRAMANIAM: *Magnetic Susceptibilities of Some Organic Compounds in Different Physical States.*—The changes in magnetic anisotropy on melting and solution can be attributed to the break-up of polymers present in the solid state. P. S. VARADACHARI AND K. C. SUBRAMANIAM: *Magnetic Studies of Sulphur and Some Sulphur Compounds.*—Solutions of sulphur in carbon disulphide and sulphur monochloride have been studied by the Curie method. There is no evidence to indicate the presence of S_2 in sulphur monochloride solutions. B. R. SETH: *Vortex Motion in Rectangular Cylinders.* S. PARTHASARATHY: *Diffraction of* Light by Ultrasonic Waves.—A detailed relation between the angle of inclination of the oscillating quartz, and the diffraction spectra produced by it *at these angles, is given.* N. S. NAGENDRA NATH: *Neutrinos and Light Quanta.*—It is found necessary to introduce the spin of the neutrino in the neutrino theory of light in order to obtain two photon operators for each energy state of photons and derive the Planck formula. C. V. RAMAN AND N. S. NAGENDRA NATH: *The Diffraction of Light by High Frequency Sound Waves: Part V. General Considerations—Oblique Incidence and Amplitude Changes.*—The intensity distribution will not be symmetrical in general. R. K. ASUNDI AND R. SAMUEL: *Electronic Configuration and Bond Energy.*—The method of molecular orbitals can be satisfactorily interpreted as an electron pair-bond theory of valency. S. PARTHASARATHY: *Ultrasonic Velocities in Organic Liquids. Part III.—Esters and Ethers.* MOHD. ISRARUL HAQ AND R. SAMUEL: *On the Absorption Spectra and Linkage of Inorganic Nitrates and Sulphates in the Vapour State.*—The bond between the metal and the oxygen atom in the nitrates and sulphates for the vapour state is of the covalent type.

May 1936. SECTION B.—A. C. JOSHI AND J. VENKATESWARLU: *Embryological Studies in the Lythraceæ III.*—A study of the structure and development of the ovule and the embryo-sac in *Ammania*, *Nesæa* and *Woodfordia* and the development of pollen, male gametophyte, endosperm, embryo and seed in the family. M. S. RANDHAWA: *Marked Periodicity in Reproduction of the Panjab Freshwater Algæ.*—Observations extending over two years have shown that in hot summer months, when nearly all ponds and tanks dry up, the *Oedogonium* is found in perennial streams only. In the rainy season very few algæ with thick-walled oospores are seen. In the autumn the *Spirogyra* become fertile. The *Rhodophyceæ* show a luxuriant growth in cold freshwater stream during winter. In the months of spring—March, April and May—nearly all algæ with thick-walled oospores and zygospores are in a ripe condition. M. S. RANDHAWA: *Genus* 'Anabænothrix' *and Parallelism in Evolution in Freshwater Algæ.*—A detailed description of three species of *Anabæna*-like blue-green algæ is given. M. A. H. QADRI: *Studies on the Mouth-Parts of Mallophaga Infesting North-Indian Birds.*—A comparative study of a large number of forms from simpler to specialised ones.

National Academy of Sciences, India:

May 1936.—D. N. MOGHE AND R. V. SASTRY: *The Field of a Non-Static Spherical Condensation.*—A generalisation of Schwarzschild's internal solution for an incompressible fluid sphere is given. V. V. NARLIKAR AND D. N. MOGHE: *A Note on a General Line-Element.* N. R. DHAR AND E. V. SESHACHARYULU: *Nitrogen Fixation and Azotobacter Count on the Application of Molasses and Sugars to the Soil in Fields—Part I.* N. K. SAHA: *On the Reconstruction of the Mass-Defect Curve and the Stability of Beryllium Isotope* Be^8_4.—The mass-defect curve for the nuclei He^4, Be^8, C^{12} Si^{28} forming the series X^{4n}_{2n} is constructed on the new "mass-scale" with the help of transmutation data and the few new mass-data of Bethe. M. N. SAHA AND L. S. MATHUR: *A Critical Review of the Present Theories of the Active Modification of Nitrogen.*—All the existing theories regarding the phenomenon of active nitrogen have been criticised. It is concluded that atomic nitrogen has nothing to do with the active modification and the experiments which establish its presence are not correctly interpreted. It is shown that the long life of the afterglow which is about 5½ hours according to the recent experiments of Lord Rayleigh throws a new complexion on the phenomenon. It is thought that in active nitrogen the molecule is raised to some state composed of two ^2D atoms and probably located at 9.77 volts. JAGRAJ BEHARI LAL: *A Note on the Colouring Matter of the Flowers of* Lantana camera *Linn.*—The anthocyanin colouring matter has been isolated. N. L. PAL: *Hydrogen Ion Concentration and Titratable Acidity at Different Stages of Fruit Ripening.*—There is no direct relationship between the pH and titratable acidity. N. R. DHAR AND S. K. MUKERJI: *Alkali Soils and Their Reclamation—Part I.* N. K. CHATTERJI: *Studies in the Respiration of Mango Leaves* (Mangifera Indica).—The Ontogenic drift of *Mangifera* leaves in relation to CO_2/O_2 activity has been traced out. G. R. TOSHNIWAL, B. D. PANT, R. R. BAJPAI AND B. K. VERMA: *Study of Ionosphere at Allahabad.*—Observations for November and December, 1935, show that 75 meter waves are usually reflected from the F-region. Sporadic E reflections, however, have been observed on several nights. HAR DAYAL SRIVASTAVA: *New Hemiurids (Trematoda) from Indian Marine Fishes.—Part I.—A New Parasite of the sub-family* Prosorchinæ *Yamaguti*, 1934.—A new species of the genus from the intestine of the fish *Seriolichthys bipinnulatus* from Puri, Bay of Bengal, is described. HAR DAYAL SRIVASTAVA: *New Allocreadids (Trematoda) from Indian Marine Fishes,—Part I.—New Parasites of the Genus* Helicometrina *Linton*, 1910.—Two new species of the genus *Helicometrina* Linton obtained from marine fishes at Puri, Bay of Bengal, are described.

Indian Chemical Society:

March 1936.—S. K. SHARMA: *Application of the Thiocyanogen Value in the Quantitative Determination of Oleic and Linolic Acids in Natural Oils, which are Free from Linolenic Acid, according to Kaufmann.* N. R. DHAR AND S. K. MUKERJI: *New Aspects of Nitrogen Fixation and Conservation in Soil. Part I.* N. R. DHAR AND S. P. TANDON: *Oxidation of Nitrites to Nitrates in Sunlight.* (LATE) ANDREW NORMAN MELDRUM AND MORESHWAR GOVIND BHOJRAJ: *Condensation of Chloral with Acid Amides. Properties of—CH(OH).CCl$_3$ Group.* PHULDEO SAHAY VARMA AND C. SREENIVASMURTHYACHAR: *Halogenation. Part XIV.—Iodination of Aromatic Hydrocarbons and Bromotoluenes.* PHULDEO SAHAY VARMA AND M. K. SRINIVASAN: *Halogenation. Part XV.—Chlorination and Bromination of Cumene and p-Cymene.* PHULDEO SAHAY VARMA AND T. S. SUBRAHMANIAN: *Halogenation. Part XVI.—Bromination and Iodination of Mesitylene.* SUSIL KUMAR RAY: *Parachor and Chemical Constitution. Part V.—The Structure of "Liquid Crystals".* ASHUTOSH DAS AND RAJENDERLAL DE: *Negative Ferric Hydroxide Sol.—A Modified Method of Its Preparation.* PROMODE BEHARI BHATTACHARYYA AND KALIPADA GANGULI: *On the Physico-Chemical Properties of Electrodialysed Gels of Silica, Alumina, Ferric Hydroxide and Their Mixture. Part I.—Ion Exchange.* (LATE) A. N. MELDRUM AND R. D. KOTWAL: *A Note on the Constitution of the Reduction Product of Trichloromethylparaconic Acid.*

The Indian Botanical Society:

June 1936.—P. C. MALLICK: *A Device for maintaining Constant Temperature and Humidity in a Glass Chamber.* C. V. KRISHNA IYENGAR: *A New Type of Electric Recorder for Plant Autographs.* D. P. MULLAN: *On the Mucilage-Glands and Absorbing Hairs of* Pedalium murex *Linn.* J. H. MITTER: *Some Recent Contributions to Our Knowledge of Heterothallism in Fungi* (*Presidential Address, Ind an Botanical Society*, 1936). E. W. ERLANSON: *Plant Colonisation on Two New Tropical Islands.*

Meteorological Office Colloquium, Poona:

May 12, 1936.—Dr. K. R. Ramanathan.—"Stüve and Mügge's paper on 'Energetics of weather'."

May 19, 1936.—Mr. S. Basu.—"Emmon's paper on 'Atmospheric structure over the southern U.S.A. Dec. 30–31, 1927, determined with the aid of sounding balloon observations'."

May 26, 1936.—Dr. S. K. Banerji.—"Application of Kinematical laws of an Isobaric Field deduced by Dr. Pettersen."

University and Educational Intelligence.

University of Bombay:

The Syndicate have decided that the Professorship of the Department of Chemical Technology be renamed the *Ranchhoddas T. Mody* Professorship of Chemical Technology from the 5th June 1936 in accordance with the direction of the Court. As, however, it is not possible to pay the entire salary of the Professor out of the income from the Endowment, the Senate will have to make an annual grant to meet the expenditure.

It is proposed to increase the number of Scholarships in the Chemical Technology section to 6—two for the first year and four for the second—each scholarship to be of the value of Rs. 50 per month. It is also proposed to increase the Fellowships to 4, each being of Rs. 75 per month. The Fellowships will be filled up only as the research scheme progresses and after a report has been received on the work done by the present Research Fellows.

University of Calcutta:

Grants.—The Senate at their meeting held on 23rd May, sanctioned a grant of Rs. 3,000 to the *Narasiksha Samiti*, Calcutta, out of the Rai Viharila! Mitra Fund for the furtherance of their schemes for the training of teachers.

Change in Regulation.—Aeronautics has been introduced as an alternative subject in the course of studies for the B.E. degree examination in Civil and Mechanical Engineering.

Lady Hassan Suhrawardy Medal.—Sir Hassan Suhrawardy has offered 10 shares of the Reserve Bank, of the face value of Rs. 1,000 for creating an endowment in the name of his wife, the late Lady Shahar Banu Begum Suhrawardy. Out of the interest of the amount, a medal will be awarded annually to a lady graduate of the Faculties of the University for the best essay on Health Education.

Ghosh Professor of Applied Chemistry.—The Senate, at the meeting held on 23rd May, appointed Dr. Bireschandra Guha, D.Sc. (Lond.), to act as Ghosh Professor of Applied Chemistry with effect from 1st June 1936 to 30th April 1937.

Ghosh Travelling Fellows for 1936–37.—Subodhchandra Ray, Esq., M.A. (Subject: 'Education of the Blind'); Dhirendranath Banerjee (Subject: Cholera Kidney and Cholera Toxin).

Award of Research Degrees.—Mr. P. C. Mahanti, M.Sc., has been admitted to the degree of Doctor of Science for his thesis entitled "Investigations on the Band-Spectra of Diatomic Molecules" and "Studies of Electric Movements".

Research Scholarship for Mining and Metallurgy. It is understood that the Consul-General for America has informed the Calcutta University that a scholarship for the academic year of 1936–37 is available for Indian students at the Montana School of Mines. The School is located in one of the principal mining and metallurgical centres of the world and offers a 4-year course leading to a Bachelor of Science degree in the fields of mining, engineering and metallurgy including ceramics. One scholarship is offered for each consular district. In the case of Calcutta consular district, this would signify Bengal, Assam, Bihar, Orissa, the United Provinces, the municipal districts of Delhi and Simla, the Indian States within this area, Sikkim, Bhutan and Nepal. If, however, two or perhaps more students should be interested, they may make applications in the usual way direct to Dr. Francis A. Thomson, President, Montana School of Mines, Buttee, Montana, not later than August 1936.

University of Madras:

I. M. R. Ry. Rao Bahadur A. Lakshmanaswami Mudaliar, Avl., B.A., M.D., F.C.O.G., has been appointed full-time Vice-Chancellor during the period of leave of the permanent Vice-Chancellor, Mr. R. Littlehailes, C.I.E., M.A., from the 5th June to the 28th August 1936.

II. Dr. M. Damodaran, M.A., D.Sc., F.I.C., Director, University Biochemical Laboratory, has been promoted from the grade of Reader to that of Professor in the scale of Rs. 750–50–1,000.

III. Messrs. S. Vaiyapuri Pillai, B.A., B.L., and R. P. Sethu Pillai, B.A., B.L., have been appointed Reader and Senior Lecturer in Tamil in the Oriental Reserach Institute.

IV. The following persons have been declared qualified to receive the Degrees noted below :—

Doctor of Philosophy.—

1. Miss C. Minakshi, M.A., for her thesis "Administration and Social Life under the Pallavas, The Kailasanatha Temple, etc.".
2. Miss Eliza V. Paranjoti, M.A., L.T., for her thesis "Saiva Siddhanta".

Doctor of Science.—

S. Gopalakrishnamurti, M.A., for his thesis "Atomic Energy, States of Tellurium, Iodine and other Related Elements".

Master of Science.—

1. N. Kesava Panikkar, B.A. (Hons.), for his thesis "Studies on South Indian Brackish Water Actiniaria".
2. P. K. Sesha Ayyar, B.Sc., for his thesis "Absorption and Fluorescence Spectra of Organic Compounds".
3. T. K. Srinivasan, B.Sc., for his thesis "Action of Sulphuric Acid on Cotarnine, Action of Bromine on Narcotine, etc."
4. T. Varahulu, B.A., for his thesis "Physical and Chemical Studies on Sugarcane-Jaggery".

V. The Sir J. C. Bose Prize of the value of s. 350 has been awarded to Mr. Kaviraj Dhirendranath Ray, M.Sc., Calcuttla, for his thesis on "A Critical Study of Hindu Medicine".

University of Mysore:

Examinations :

The results of the examinations held in March 1936 were announced. They were as folllows:—

Sl. No.	Name of Examination	Examined	Passed
1	Intermediate	1,151	418
2	B.A. (New)	126	65
3	B.A. (Old)	37	9
4	B.Sc. (New)	150	60
5	B.Sc. (Old)	1	..
6	B.A. (Hons.) Preliminary ..	37	26
7	B.Sc. (Hons.) Preliminary ..	58	48
8	B.A. (Hons.) Final ..	32	29
9	B.Sc. (Hons.) Final ..	37	29
10	M.A. Qualifying Test ..	2	2
11	M.Sc. Qualifying Test ..	2	2
12	B.T.	66	43
13	F.E.	74	48
14	S.E.	77	50
15	B.E.	38	30
16	Second M.B.B.S. .	31	14
17	Final M.B.B.S.	35	11

Recognition of Medical Degrees by the British Medical Council.

The Executive Committee of the British General Medical Council has resolved that the degree of M.B., B.S., granted by the Universities of Bombay, Lucknow and Madras together with other qualifications granted by the Universities of Bombay and Madras, which were presumably registerable, should again be recognised for registration if granted on or after February 25, 1930, and that the degree of M.B., B.S., granted by the University of Patna should be recognised for registration if granted on or after May 11, 1935, the date on which the University was included in the first schedule to the Indian Medical Council.

Reviews.

Introduction to Quantum Mechanics. By L. Pauling and E. B. Wilson, Jr. (McGraw-Hill Publishing Co., Ltd., London, 1935.) Pp. xiv + 468. Price 30*s*. net.

In the course of the ten years since its inception the subject of Quantum Mechanics has grown with extreme rapidity and has now reached a stage when the foremost scientists are acutely conscious of the necessity for new fundamental extensions. No student of Physics or Chemistry can now afford to be ignorant of the methods and important results of this young branch of knowledge. There is no dearth of books on the subject : in fact most of the advanced general text-books contain chapters dealing with the fundamentals. Still the new book by Pauling and Wilson fulfils a definite want, *viz.*, that of the student with limited mathematical equipment who is desirous of acquiring a good working knowledge of the subject. The classical books in this field have set out with the intention either of providing an authoritative compendium for specialists or exhibiting new ways of presentation. The book under consideration has, on the other hand, the student and the non-physicist constantly in mind and the treatment is suited to self-study. It is very encouraging to the student to be told that "an extensive previous knowledge of partial differential equations and their applications in

mathematical physics is not a necessary prerequisite for the study of Wave Mechanics and indeed the study of Wave Mechanics may provide a satisfactory introduction to the subject for the more physically minded or chemically minded student". The spirit displayed in this quotation runs through the entire book. In keeping with this point of view matrix mechanics and Dirac's theory receive only a very brief introductory treatment at the end of the book. Wave Mechanics is, on the other hand, treated in detail and its several methods are lucidly explained with applications to definite problems. The two introductory chapters give the student an excellent orientation towards the problems of the old quantum theory, which first found a solution in Quantum Mechanics. The Schrodinger equation is introduced on its own merits as being a description of Nature worthy of confidence just like the second Law of Thermodynamics. The necessity for the existence of eigen-values of the parameters occurring in a differential equation is finely illustrated by a geometric consideration. The subsequent chapters deal with the solutions of the Schrodinger Equation in the various well-known cases of the oscillator, the rotator, the Hydrogen atom, etc., the mathematical steps being fully explained and the properties of the new functions encountered being derived as occasion demands. The Schrodinger Perturbation theory is fully explained with illustrative examples while the other methods of approximately solving the wave equation such as the variation method, the Wentzel-Brillouin-Kramers technique, Slater's method for many electron systems, and Hartree's method of the self-consistent field are explained without going into details in the case of the more difficult of these methods. The student is now and again assisted by timely repetition of definitions. The Helium atom, the Hydrogen molecule-ion and the Hydrogen molecule are discussed in detail as providing typical examples of the methods previously explained. The rotation and vibration of diatomic and polyatomic molecules are briefly considered and Quantum statistics, and the Uncertainty Principle are also touched upon. There are a number of appendices, most of them giving mathematical details kept out of the body of the book. Some problems to be worked by the student are appended to the various sections. Their value will be enhanced if some hints for their solution and the results are briefly given, say at the end. As is usual with American publications the book is finely got up, and somewhat highly priced. We have noticed a few harmless misprints, *e.g.*, on pages 264, 282, etc. Every advanced student of Physcis and Chemistry may heartily be recommended to make a close study of the book. We are convinced that the perusal of more advanced treatises and the original papers will then occasion no difficulty.

Mathematics of Modern Engineering. Vol I. By R. E. Doherty and E. G. Keller. (John Wiley & Sons, New York; and Chapman & Hall, Ltd., London, 1936.) Pp. 1–314 (i–xxi). Price 17*s.* 6*d.* net.

This joint work of "an engineer who has worked with mathematics and of a mathematician who has worked in engineering tempered by the atmosphere of the engineering office and the class-room" is designed as a course of study for undergraduates who aspire to work later in the higher levels of engineering service. Not the least interesting part of the work is the foreword to instructors wherein is explained the method of approach of the authors towards mathematical teaching in engineering institutions. This foreword of nine pages ought to be printed as a separate brochure and free copies of the same supplied to those who are responsible for the direction of engineering studies in this country as this would go a long way in bringing about the right attitude of engineers towards mathematics in place of the prevailing misconception that relegates it to the position of the Cindrella of the engineering curriculum. One very frequently hears the cry that mathematics taught at college is absolutely useless to the engineer in "after life". To people of this frame of mind the reviewer would strongly recommend a careful reading of pages xii–xiii of this foreword. It comes as a surprise that in the General Electric Organisation fifteen years ago practically all the engineering problems requiring real scientific analysis were referred to a very few individuals most of whom had received their college training abroad and that a remodelling of the courses of study with a definite orientation towards mathematical and theoretical work has gone a long way towards setting this right. According to the authors "the thing that seems to count professionally is the cultivated intellect" and there is no better way of securing this than by a rigorous discipline in mathematical

analysis. While it is true that the majority of engineering graduates of the average calibre have no opportunities for original work, it is a suicidal policy to frame the curricula of engineering studies with only such types in view. What is wanted is a course that is suited to produce engineering graduates who are capable of exercising leadership not only in the highly technical sides of engineering but also in commercial engineering and in executive capacity. This book is designed as a course for undergraduates who aspire to such leadership.

The difficulties of writing a text-book to suit these needs is however very great. The recent advances in engineering have utilised the services of so many branches of higher mathematics that it would be impracticable to incorporate accounts of all these in a book designed primarily for engineers. There is perhaps no branch of engineering so elusive or undefined as "Engineering Mathematics" and certainly none more often sinned against. We have scores of text-books on this topic which are either a heterogeneous collection of problems from different branches of engineering collected to illustrate special mathematical methods or a sort of collection of mathematical formulæ, at best a *mathematiker Hilfsmittel* for engineers. The list of the branches of mathematics used to-day in engineering which the authors have prepared makes imposing reading and serves to bring home this difficulty vividly. Theories of periodic orbits, the special three body problem, the damped pendulum, quasi-differential and integral equations, partial differential equations of the eighth order, dyadics and tensors, calculus of variations, vector analysis, Heaviside operational calculus, dimensional analysis, topology, analytic theory of differential equations and theory of functions of a complex variable constitute a formidable list indeed. Add to these, the theory of matrices and Riemannian and non-Riemannian geometry and one has a clear idea of the impossibility of writing a book giving accounts of all these topics.

One could, nevertheless, adopt the compromise of preparing a suitable mathematical environment for the proper appreciation of these topics and this appears to be the method chosen by the authors. With only the first volume before us it is difficult to judge correctly how far the authors have been successful in this attempt. This volume consists of four chapters. The first giving a general introduction to the mathematical formulation of engineering problems is admirably done. The second chapter, headed "Basic Engineering Mathematics," treats ordinary differential equations, determinants, Fourier series, solution of algebraic and transcendental equations, dimensional analysis and graphical and numerical methods. This chapter contains, therefore, most of the mathematical methods in every-day use in engineering and the authors are to be congratulated on their treatment of solutions of equations and dimensional analysis. This book shows better than any other the great power of the method of dimensions. Particular mention may be made of the exhaustive discussion of Græffe's general theory and the π theorem of dimensional analysis. The inclusion of the principle of similitude is a welcome and novel feature. The third chapter on vector analysis, although it covers only about fifty pages is just as good as, if not better than, most elementary texts on the subject like those of Gans or Runge or Coffin. It also contains a short but excellent introduction to dyadics. The fourth chapter on Heaviside's operational calculus, gives the latest developments in this branch and incorporates the unusual but extremely welcome practice of adding a good introduction to the theory of functions of a complex variable. This was the right place where the authors might have introduced an account of integral equations but perhaps this is reserved for the second volume.

If the contents of Vol. I are any indication of what the second volume is going to be, we can safely say that this series will easily constitute one of the best works on Engineering Mathematics so far published. If an Honour's Course in Engineering is ever established in our Universities this book might be unhesitatingly described as an ideal text-book. Even otherwise some of the methods and topics dealt with in the book would be very usefully taught in the ordinary courses.

Prominence may be given to the authors' coining of the phrase "*Engineering functions*" for the "well-behaved" functions $y = f(t)$ which are such that in $t_1 < t < t_2$,

(i) y is not infinite,
(ii) there is exactly one value of y for every value of t,
(iii) y has only a finite number of maxima or minima, and
(iv) y has not more than a finite number of finite discontinuities.

B. S. M.

Graphical Solutions. By C. O. Mackey, Cornell University. (John Wiley & Sons., New York; Chapman & Hall, Ltd., London, 1936.) Pp. 1–130. Price 12*sh*. 6*d*.

The title of this work indicates that it treats of the solutions of different engineering problems by graphical methods. The scope of the book is, however, not so exhaustive. Problems of graphic statics, graphical solutions of algebraic, transcendental and differential equations and the graphical methods of Fourier analysis do not find any place in the book. In the author's own words, he has "not attempted to read and abstract everything that has been written on the subject" of graphical solutions. The book is the outcome of a course of lectures offered by the author himself and confines itself to solution of equations and derivation of functional relationships by the methods of scales and charts and the problem of curve fitting. The treatment is elementary without sacrificing elegance or clarity. It is eminently practical and is illustrated by a wealth of examples, mostly from problems of mechanicsl engineering.

The chapters on intersection charts and alignment charts go much farther than most books on the subject. The author goes up to the limit of the construction of net work charts to solve equations in five variables. The use of determinants in constructing alignment charts with three scales is a novel feature of the work.

The best part of the book is the last chapter wherein is given an excellent account of the constantly recurring problem of finding an empirical equation to fit observed experimental data. A detailed treatment is given of the determination of constants when the assumed equations are known by applying the methods of selected points, residual summation and least squares. The treatment of three-constant empirical equations is also exhaustive and one would have liked to have the hyperbolic functions introduced here. While the methods for determination of constants is fully explained, nowhere does one find methods for guidance in the choice of the number of constants in the empirical equation tried for a particular set of data.

This book will certainly be of great use to students of mechanical engineering, especially in the study of heat engines. The last chapter on curve fitting deserves to be very widely known to all practising engineers. The printing and get-up are excellent and the price too appears reasonable.

B. S. M.

Commercial Fertilisers, Their Sources and Use. By Gilbert H. Collings, Associate Professor of Agronomy, Clemson Agricultural College. (P. Blackiston's Son & Co., Philadelphia, 1936.) Pp. xiv + 356. Price $3·25.

A compendious text-book suitable for use in Colleges of Agriculture and comprising practically the author's class-room lectures in the subject, this handy volume will be found to meet the needs of a much wider circle of agriculturists than the College students for whom it is primarily intended. The author takes full note of the great development in fertiliser research in recent years and of the many important changes in the concepts on plant nutrition and has made a special point of giving actual research findings gathered comprehensively from most important research centres. American experience naturally predominates but on fundamental questions all available sources are laid under contribution. Descriptions are given of the sources, the methods of manufacture and trade relating to all the different commercial fertilisers at present on the market including the new products like Ammophos, Leunophos, Nitrophoska, Nitropotasse, Nitrochal and so on, while among organic manures the preparation and value of synthetic or artificial cattle manure is also described. The description of the methods of fixation of atmospheric nitrogen cover all known methods though one wishes they were fuller. So likewise are the methods of manufacturing superphosphates and the several concentrated and reinforced forms of this important fertiliser. The chapter on the borderland problems like the fertiliser value of elements other than nitrogen, phosphorus, and potassium forms interesting reading and fairly summarises present-day ideas as far as they can be on such a fast moving new branch of research. Sulphur, magnesium, iron, manganese, sodium, boron, chlorine, copper and even radium are touched upon under this head and their rôle as far as is known is indicated. "What fertilisers shall I use for my soil and how much ?" is certainly the question for which the interested reader would like to obtain a helpful answer in a book of this kind ; we are still far away from being able to give a precise answer to this practical question of every-day importance

without running the risk of dogmatism or half knowledge. The doses recommended vary within very wide limits and afford at best only reasonable guidance. Nevertheless research is continuously in progress to devise methods of determining the manurial needs of soils quickly enough for practical purposes and the name of Wagner, Kellner, Ville, Neubauer and Schneider will readily be remembered in this important branch of research. The book gives a full and interesting account of the various laboratory tests, the Neubauer, Hoffer, Thornton, and the Troug methods—all of which are used with varying degrees of usefulness for this purpose. We should have preferred greater emphasis being placed on the importance of field experiments in this connection and an account given of some of the excellent methods coming into vogue nowadays which are designed to reduce errors in field trials to a minimum and to afford quick and fairly reliable answers. This we believe is somewhat of a serious omission in an otherwise comprehensive text-book.

A useful feature of the book is the section on the calculation of quantities of manures required to make up mixtures from various formulas and for judging comparative valuations of the different fertilisers on the market from "Unit" values. Several examples are worked out, which will be found very helpful. The statistics of the world's resources, production, and trade of the different fertilisers should interest the lay reader and are quite impressive. Germany, for instance, leads in the use of fertilisers with a total annual consumption of about 1,800,000 tons, with the U.S.A., France, Japan, Italy, the Netherlands and Great Britain coming next in the order mentioned; the U.S.A. leads in the use of phosphatic fertilisers, while Germany leads in the use of nitrogenous and potash fertilisers. The per acre consumption of fertilisers for the cultivated area is put down at 105lbs. for Holland, 70lbs. for Germany, 33lbs. for France, and Great Britain, and only 10 lbs. for the U.S.A. The world's reserves of fertiliser minerals are also estimated and it is computed that even at the present rate of consumption they cannot last for more than a thousand years. What will happen if India and China should begin to use artificial ferilisers as largely as Europe and America or if the latter should use them at the rate at which a country like Holland is using is rather a frightening prospect for mankind on this globe. The book is both interesting and up-to-date and should form a welcome additon to the number of text-books on the subject at present in use.

A. K. Y.

Introduction to Human Parasitology. By Asa C. Chandler (Chapman & Hall, London, Fifth Edition, 1936.) Pp. xvi+661. Price 25*sh*.

Since the publication of the fourth edition of this work in 1930 the science of Human Parasitology has undergone much change and numerous new problems have arisen while many of the old ones have become clarified. It seems to be the sad fate of humanity to fall a constant prey to one disease or another and probably the discovery of new maladies or fresh strains of old ones will continue as long as discerning man lasts. The discovery of a disease brings in its wake numerous problems of importance; the discovery of the parasitic organism, the study of its life-history, the methods of prevention and cure of the disease, etc., and indeed no problem of human welfare has received so much attention as human parasitology.

The author of the book under review, who is a parasitologist of great repute and long experience, has brought out a volume which has all the merits of a scientific treatise without the disadvantages of its narrow outlook. The story of the ills to which the flesh of man is prone, is a fascinating story though sordid in its details, and the usefulness of a work of this sort can only be judged by the extent to which the moral of the story is brought home to the readers. The long chapter on the part Bacteria play in undermining the health and happiness of the human race does not form part of the book and the author begins his account with the Spirochætes, though it must be admitted that the Spirochætes resemble Bacteria more than they do the Protozoa but "until the bacteriologists are prepared to assume full responsibility for them, the protozoologists will have to care for this orphan which Schaudinn left on their doorstep". But like all orphans, the Spirochæte is a most active, adaptable and vivacious organism and not a little misery and unhappiness are to be laid at its door. Relapsing fever and Syphilis would conjure enough pictures to treat them with scientific severity rather than with careless contempt.

It appals one to think that animals so low in creation as the Protozoa could wield so much power over human life. Nevertheless

it is true that this group of tiny animals is responsible for the death, annually, of an incredible number of humans. Malaria alone takes a toll that defies imagination, and that, even though practically everything is known about it. To this may be added the more important of the others,—Amœbæ, Trypanosomes and Leishmanias—a pretty kettle to stew man in. Then there are the worms, some of which like Schistosoma Trichinella, Ancylostoma and Filaria add not inconsiderably to the woes of man. The importance of Arthropods in this scheme of things is two-fold; a few are themselves parasites of no mean calibre but their real interest lies in the fact that they act as transmitters and intermediate hosts of myriads of smaller parasites conveying them from man to man and themselves none the worse for it. Ticks and mites, bed bugs and lice, flies and mosquitoes, fleas and gnats form a most imposing array of organisms which have all conspired to make man the unhappy animal that he is. Indeed, one would be tempted to single out any one of these and ask like the poet, "Did He who made the lamb make thee."

Such is the material which the author has endeavoured to present, not only to the layman but to the specialist as well, in the six hundred and odd pages of packed information. The parasites and their life-histories, the characters, the treatment and methods of prevention of the diseases caused by them are all dealt with in great detail. Useful and practical hints are offered for the alleviation of human suffering caused by the parasites, and throughout the book, there is a piquancy of style so essential in dealing with a problem of this sort. A fascinating story fascinatingly told.

B. R. S.

The Indian Zoological Memoirs. I.–Pheretima. By Karm Narayan Bahl. (Lucknow Publishing House, Lucknow; Second Edition, 1936.) Pp. x+85. Price Rs. 1-8.

The revised and enlarged second edition of this book has just been published. It will be remembered that in 1926, Dr. K. N. Bahl who is the editor of the *Indian Zoological Memoirs*, himself brought out the first of the series on the Indian Earthworm, Pheretima. A number of useful additions have been made in this edition as compared with the first one published ten years ago. In the introduction has been incorporated a classification of the Chætopoda and a list of Indian Oligochæta and more especially, the species of Pheretima, has been compiled, which will doubtless prove useful to all students of Indian earthworms. The chapter on Receptor organs is an addition while that on the habits and distribution has been amplified. The chapter on Development, has been expunged from the second edition, for reasons which the reviewer cannot quite follow. The *Memoir* does not restrict itself to the anatomy only and the information contained in the chapter on Development would not have been out of place. Many of the other chapters have been rewritten and all the latest literature on the subject has been incorporated. The paper used in the second edition is better and the types are clearer. It must be admitted, however, that the binding is very flimsy and the copy in the hands of the reviewer is already threatening to disintegrate. The book is in keeping with the latest of the series of the *Memoirs* more recently issued and it will prove useful in all colleges and schools where the Indian Earthworm is studied.

B. R. S.

Electrical Engineering in Radiology. By L. G. H. Sarsfield, M.Sc., M.I.E.E., A.Inst.P. (Chapman & Hall, Ltd., London, 1936.) Pp. 284. Price £1 5*s*.

Mr. Sarsfield has supplied a long-felt want in his admirable treatise on "Electrical Engineering in Radiology".

The Radiological Research Department at Woolwich has done splendid work for many years and Mr. Sarsfield has had ample opportunities of studying at close quarters all the problems he deals with in his book which has a large number of illustrations and many plates. There is a very good section on the lay-out, fittings and electrical dangers of Radiological Departments and the book is the most comprehensive work on the subject yet published. No X-Ray Department of any standing should be without a copy.

T. W. BARNARD.

La Diffraction des Electrons dans ses Applications. By Jean J. Trillat. [Actualités Scientifiques et Industrielles.] (Hermann et Cie, Paris, 1935.) Pp. 59. Price 18 *Francs*.

The publication of this excellent monograph on the diffraction electrons and its application by Professor Trillat is very opportune. Much work has been done in this branch of physics during recent years

and the need of a suitable book on the subject is often felt. This need is now met by the above monograph by Professor Trillat who is himself a pioneer in this field of research.

The monograph is divided into five chapters, the first of which deals briefly with the apparatus and experimental methods. In the second chapter is set forth all the recent work on the application of electron diffraction to the elucidation of the surface structure of metals, structure and orientation of crystals in metallic deposits, the nature of polish and other allied subjects. All the recent work on these lines by various workers in the field like G. P. Thomson, Finch, Kirchner, Trillat and others find a place in this chapter. Professor Trillat's work on the structure of thin films of long chain organic compounds like fatty acids, cellulose and rubber is also discussed in detail. The last two chapters are devoted respectively to the diffraction of electrons by gases and vapours, and to the diffraction of slow electrons. The monograph is well written in easy French and contains a comprehensive Bibliography on the subject which adds very much to its value. Perhaps the monograph would have been even more useful and valuable if the use of electron diffraction (in gases and vapours) for the study of molecular structure had been discussed a little more in detail. It can be recommended to all students of physics who wish to make a preliminary study of the subject before studying original papers. The monograph is sure to be welcomed by all workers in this field.

S. R. S.

La determination du sexe et heredite. By par Emile Guyénot. [Actualités Scientifiques et Industrielles.] (Hermann et Cie, Paris, 1935). Pp. 77. Price 20 *francs*.

A review of our present knowledge of the factors which control the appearance of sexuality in the lower animals, is written for general students and non-specialists. Known instances of sex-inversion in fish, amphibians and birds are described together with the results obtained when males were crossed with males, and females with females. Different types of sex-heterochromosome combinations are illustrated, as well as their behaviour during maturation. Sex-linked inheritance is explained by diagrams.

In connection with intersexes the author calls attention to the essentially unstable nature of the physical manifestation of sex (phenotype), which is dependent upon the attainment of an equipoise between two antagonistic sets of physiological factors. Both sexes are bipotential. There is no definite demarcation between maleness and femaleness and the relative position at which a state of balance is attained in each individual is determined by both genetic and environmental influences.

It is regrettable that the author decided to omit all bibliographical references merely because his work was of a limited scope. For this very reason the need for a list of sources is felt. Sex in humans is not dealt with and plants are barely touched upon. The reader of this useful review will want to learn more about the subject. Sex concerns everyone, and some knowledge of chromosome, and of which parent determines the sex of the offspring would destroy many superstitions even among the educated.

A Glossary of Technical Terms for Use in Indian Forestry. Indian Forest Records, New Series, Vol. II, No. 1. (Manager of Publications, Delhi. 1936.) Pp. 45. Price As. 5 or 6*d*.

In any technical vocabulary, words often have or acquire meanings which bear no relation to their original significance in common parlance. In Forestry, there is a further complication inasmuch as some of the terms used are defined by State Legislation, so that the same word used professionally connote different things in different countries. Just to cite an example, the term "Cattle," under the Indian Forest Act includes elephants, camels, buffaloes, etc. The appearance of *A Glossary of Technical Terms for Use in Indian Forestry*, therefore, fills a very real want in the profession. It is authoritative, being adopted for official use by the Silvicultural Conference, Dehra Dun, 1929, and revised in 1935.

By minimising cross references, the bulk of the book has been, with advantage, considerably reduced. The type and get-up of the Glossary make for easy reference work.

There are three Appendices. In the first is a list of the Silvicultural Systems compiled from Prof. Troup's work on the subject, with their French and German equivalents. It is noteworthy that under Shelterwood Systems, the expression "Blendersaumschlag" is given without an English

equivalent but with a short explanatory note, which gives a rough idea of the system more readily than any literal and pedantic translation. Appendix II details "Three Classification into Crown Classes" and the "Classification of Thinnings," while the last Appendix gives a list of "Forestry Terms used in the U. S. A. and their English Equivalents". One cannot help feeling that the usefulness of this Appendix would have been even more, if the German and French equivalents of the terms had also been given.

This book should find a place in the Library of everyone interested in Indian Forestry.

EMMENNAR.

India in 1933-34. (Manager of Publications, Delhi, 1935.) Price Rs. 1—10—0.

India in 1933–34 is the latest report prepared by the Bureau of Public Information for presentation to Parliament in accordance with the requirements of the 26th Section of the Government of India Act. This survey, which is issued under the authority and with the general approval of the Secretary of State for India, must not be taken to mean that the approval of either the Secretary of State or of the Government of India is implicit in every individual "expression of opinion". The report attempts to present in an abridged manner the general trend of events both in the Political and Administrative Spheres during the calendar year 1934 and outlines the developments in other departments in the financial year 1933–34. Those passages of an explanatory or descriptive character in respect of the subject-matter in former reports, have either been totally omitted or greatly reduced in length to keep down the size of the volume. The section on Provincial Administration, etc., has been left out but a separate chapter on the Bihar Earthquake forms a special feature of this volume.

The year 1934 will be handed down to posterity as one of the most memorable, if for no other reason than for the terrible seismic catastrophe which almost coincided with the beginning of the year. In respect of the area and of the extent of damage both to property and human lives, this seismic disturbance has very few rivals. The effect of the Earthquake was felt over an area of nearly two million square miles in India and Tibet alone, and was recorded by most of the seismological stations in the world. The devastations in certain areas in Northern Bihar were at once complete and widespread. The loss of human lives has been estimated to be 7,253 and this must be considered as remarkable in view of the fact, that in an area of 6,000 square miles, no masonry structure was left undamaged and that twelve towns with populations ranging from 10,000 to 60,000 were wiped out.

Apart from this visitation of natural fury, the crowded period of 1934 is not without interest or material. Political interest, in the main, is centred in the activities of the National Congress. The suspension of civil disobedience, which had borne no practical fruit, was as much an indication of the policy of Government as the realisation of the futility of resistance to constituted authority on the part of individuals comprising the Congress Executive. By the conclusion of the period under review, the Joint Parliamentary Committee Report was published, which may be considered as the culmination of a definite stage in the unremitting efforts to bring about constitutional reform for India. A noticeable improvement in the relations between the Government and the Congress was observable throughout this period, and Government, relieved of a pre-occupation with the task of maintaining public peace which was being threatened by the civil disobedience movement, were free to attend to administrative activities, such as the scheme for the amelioration of the economic problems of the country. Among the notable enactments of economic legislation may be mentioned the Bills for the constitution of a Reserve Bank and the amendment of the Tariff Act. Another important measure, which was passed during the Winter Session of the Assembly, was the Indian States Protection Bill which seeks to protect the administration of Indian States from the unreasonable attacks in the British Indian Press. The defence policy of Government was not without discussion, and the motion that the recommendations of the Indian Capitation Tribunal's Report was unduly favourable to India was talked out. The financial position of the country is ably surveyed and the exposition of the budgetary position of India is admirably revealed in the epitome of the speeches of the Finance and

the Railway Members introducing their respective budgets.

The communal situation was far from satisfactory and tension was increasing in acuteness. Riots which partook of a communal colour occurred at various places in connection with important festivals of both Hindus and Moslems. The communal disputes in British India had their repercussions in similar incidents in Indian States also. The terrorist movement in Bengal, which had been dormant for sometime, suddenly shot into activity in the form of a dastardly attempt on the life of the Governor of Bengal. This outrage served to awaken public opinion in Bengal to this terrible menace and the press was loud in denouncing the terrorist cult.

The other important developments dealt with in this report are those relating to Agriculture, Industry, Commerce and Communication where all-round improvement was maintained. Of special significance is the treatment of matters relating to Public Health and Education in this All-India review though they are primarily provincial subjects. A brief resumé of the work of the numerous scientific surveys is appended. The year was not without a bumper crop of both provincial and All-India conferences of economic and public interest.

Great credit is reflected on the authorities responsible for the production of this excellent report, which while preserving the high standards set up by its predecessors has achieved a notable advance inasmuch as it infuses a new spirit of approach even to the most common topics.

Forthcoming Events.

Central Board of Irrigation.

THE 6th Meeting of the Research Officers and the Executive Committee (Research Committee), Central Board of Irrigation, will be held on 7th-13th July 1936, to consider:

(1) To confirm the minutes of proceedings of the Fifth Meeting of the Research Committee, held at Simla on the 18th and 19th July 1935.

(2) To discuss the reports of the Research Officers on the research work done in their Provinces during the preceding year.

(3) To report progress in respect of the following subjects brought forward from last year:—(*a*) Means of conserving irrigation water. Stauching of canals. (*b*) Design of canal falls. Preparation of type designs. (*c*) Waterlogging and land reclamation. Questionnaire. (*d*) Testing and grading of silt. Standardisation of methods. (*e*) The Lacey silt and flow theories. (*f*) Tortuosity of rivers and their training by means of embankments. (*g*) Design of work on permeable foundations.

(4) To discuss the following new subject: Means to secure the equitable distribution of irrigation water in the future.

(5) To discuss the programme of research work to be carried out during the ensuing year, and

(6) To consider the question of Research Officers meeting during the cold weather.

Imperial Council of Agricultural Research.

July 8th and 9th, 1936.—Meeting of the Sugar Committee.

July 10th and 11th, 1936.—Meeting of the Wheat Committee.

July 13th to 18th, 1936.—Meeting of the Advisory Board.

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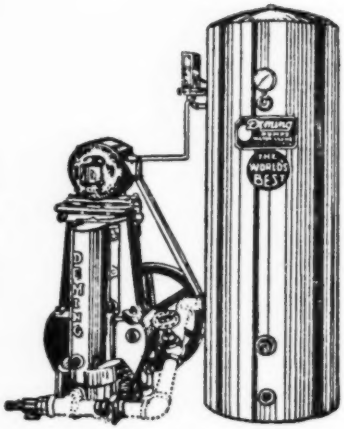

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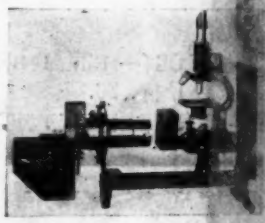
B & L BDT BALOPTICON—Model **BDT** Balopticon is a slide projector mounted on a heavy adjustable tilting base. This mounting allows for changing the projection angle for screens at various heights. For film, micro-projection and overhead projection attachments are available.

B & L MICRO-PROJECTOR—Now Bausch & Lomb offers a new Micro-Projector at a new low price. Any standard compound microscope can be used. Simply place the microscope on the stage of projector in an upright position, apply the prism reflector cap to the microscope and focus the illuminator.



OTHER BAUSCH & LOMB INSTRUMENTS—Here are some of the other B & L Products: Spectrometers, Refractometers, Colorimeters, Microscopes and accessories, Photomicrographic Equipment, Centrifuges, Microtomes, Magnifiers, Micrometers, Optical Glass, Photographic Lens.

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